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Korea
Appraisal of a Third Highway Project

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CURRENCY EQUIVALENTS*

Currency Unit	=	Won (W)
US$1	=	W 485
W1	=	US$0.0021
W1 million	=	US$2,062

*The exchange rate is floating, but the rate used in this report is indicated above.

WEIGHTS AND MEASURES
Metric System

Metric		British/US Equivalent
1 meter (m)	=	3.28 feet (ft)
1 kilometer (km)	=	0.62 mile (mi)
1 square kilometer (km^2)	=	0.386 square miles (sq.mi)
1 kilogram (kg)	=	2.205 pounds (lbs)
1 metric ton (m ton)	=	(0.98 long ton (lg ton) or 2,240 lbs) (1.1 US short ton (sh ton) or 2,000 lbs)

ABBREVIATIONS AND ACRONYMS

aadt	-	Annual average daily traffic
BPR	-	Bureau of Public Roads
DBST	-	Double Bituminous Surface Treatment
EPB	-	Economic Planning Board
ER	-	Economic Return
GNP	-	Gross National Product
KHC	-	Korea Highway Corporation
KNR	-	Korean National Railroad
MOC	-	Ministry of Construction
MOF	-	Ministry of Finance
MOHA	-	Ministry of Home Affairs
MOT	-	Ministry of Transportation
NHMO	-	National Highway Maintenance Offices
PCB	-	Provincial Construction Bureau
RCB	-	Regional Construction Bureau
TCMO	-	Territorial Construction and Management Office
TCMC	-	Transport Coordination Ministers' Conference
TPO	-	Transport Planning Office

FISCAL YEAR

January 1 to December 31

KOREA

APPRAISAL OF A THIRD HIGHWAY PROJECT

TABLE OF CONTENTS

This report has been prepared by Messrs. A.F. Ballereau (Economist) and P.R. Morris (Engineer).

ANNEXES

1. Description of Project Highways to be Constructed
2. Description of Project Highways to be Paved

TABLES

1. Domestic Freight and Passenger Traffic Data, 1967 and 1971/75
2. Public Transport Investment Plans, 1967/71 and 1972/76
3. Public Roads Network, 1974
4. Registered Motor Vehicles, 1962-74
5. Korean Motor Vehicle Production, 1962-75
6. Motor Vehicle Fuel Consumption, 1962-75
7. Highway Authorities and Agencies
8. Expenditures on Roads, 1962-66 and 1967-74
9. Highway User Charges, 1967-75
10. Design Standards for Two-Lane National Highways (Rural)
11. MOC Field Organization for Maintenance of National Highways: Implementation Schedule
12. Estimated Cost of Project
13. Project Implementation Schedule
14. Schedule of Estimated Disbursements
15. Traffic Volumes on Project Roads
16. Estimated Traffic Growth on Project Roads
17. Estimated Average Vehicle Operating Costs and Savings on Project Roads
18. Estimated Costs and Benefits Streams for Highway Construction
19. Estimated Costs and Benefits Streams for Highway Paving
20. Economic Returns and Sensitivity Analysis

CHARTS

1. Ministry of Construction
2. Bureau of Public Roads Organization

MAP

National Highway Network

KOREA

APPRAISAL OF A THIRD HIGHWAY PROJECT

SUMMARY

i. Demand for transport in Korea is increasing rapidly, in line with the long-term growth rate of the economy. GNP grew at an average rate of 10% p.a. in real terms from 1964 to 1974. In spite of the recent rise in commodity prices and the worldwide recession, the growth rate was 8% in 1974 and is expected to continue between 7% and 8%. Demand for all domestic transport grew at a rate of about 16% p.a. during the past decade. Although the growth rate is likely to be smaller in future, it is expected to continue to grow at a rate faster than the economy as a whole. Further, highways are taking a steadily increasing proportion of overall traffic, including most of the increase in passenger traffic.

ii. Following the recommendations of the Bank-financed Land Transport Survey in 1967, the Government has devoted an increasing proportion of investment to transport, especially for highways. Between 1965 and 1974 the share of investment in transport has grown from 19% to 21% of capital formation and the proportion of investment in highways has increased from 33% to about 46% of all public investment in transport. To improve planning and coordination of transport, including adequate examination of proposals for investment, the Government set up an inter-ministerial Transport Coordination Ministers Conference (TCMC) and a Transport Planning Office (TPO) in the Ministry of Transport (MOT). The staff is being trained and the planning body is expected to become gradually more effective. As a condition of effectiveness of the Fifth Railway Loan, in July 1975, the Government submitted to the Bank a time phased plan to review the role of the various transport agencies including TPO and agreed to take, in agreement with the Bank, within one year measures to ensure effective formulation and review of policies and investment proposals in the transport sector.

iii. The present public roads network in Korea is generally fairly adequate in density, but its condition is inadequate to carry the rapidly increasing traffic, particularly on the national highway system. To cope with this situation, the Government's highway investment in the third Five-Year Plan 1972-76 has a target, for national highways, of 500 km of new construction, including paving, and 3,000 km of improvement and paving of existing highways; and for provincial roads, of improvement and paving of about 3,500 km. Although these targets may be optimistic, it is expected that the national highway system will be almost completely paved by the early 1980's.

iv. Of even greater priority than road improvement is the reorganization and improvement of road maintenance. A new maintenance organization, under the Ministry of Construction (MOC), is being set up to maintain the national highway system and will carry out a program to bring its maintenance up to a satisfactory level. A start was made in a pilot province under the First Highway Project, and the organization is now being extended to the

remaining eight provinces, with equipment being financed under the Second Highway Project. The provincial works organizations, which now maintain the national highways, will then be able to concentrate on the provincial roads.

v. From 1962 onward, the Bank has financed investments in the transport sector with loans, credits and a grant, totalling US$401.4 million; including five railway projects totalling US$219.7 million; a Bank grant of US$200,000 in 1965 for the Transport Survey and a credit of US$3.5 million in 1968 for studies of highways and transport coordination, refinanced through Loan 769-KO of US$54.5 million in 1971 for the First Highway Project, a Second Highway Project for US$47 million in 1974; and a port project for US$80 million in 1973.

vi. The Third Highway Project will include construction of 195 km of national highways, paving of a further 600 km of national highways, feasibility studies for future improvement and paving of a further 1,200 km of national and provincial roads, to be followed by detailed engineering if found justified. The project was prepared through studies and engineering carried out under Loan 769-KO.

vii. The construction and paving works will be carried out by contract on the basis of international competitive bidding in accordance with the Bank's Guidelines for Procurement. The domestic contracting industry is well developed and efficient and won all the civil works contracts in the First and Second Highway Projects; it is expected also to win all the contracts in the Third Project. The consulting services to be financed will be carried out by experienced foreign firms, assisted by domestic consultants. The estimated total cost of the project is US$220.7 million. The loan of US$90 million will finance the foreign cost.

viii. The construction and paving elements of the project are aimed at lowering vehicle operating costs by improving national highways which have gravel surfaces and are inadequate to cope with increasing traffic. The new improved roads will also serve isolated agricultural and fishing production areas by improving access to consumption markets. The provision for feasibility and detailed engineering studies will help to prepare future highway projects.

ix. The project constitutes a suitable basis for a Bank loan, of US$90 million equivalent, representing about 41% of the total project cost, to the Republic of Korea for a term of 24 years including a four-year period of grace.

KOREA

APPRAISAL OF A THIRD HIGHWAY PROJECT

I. INTRODUCTION

1.01 The Government of the Republic of Korea has asked the Bank to help finance a Third Highway Project consisting of: (a) construction of 195 km of national highways: Seoul (Seongnam)-Icheon, Daegu-Masan, Pohang-Yeongdeog, and Suncheon-Beolgyo, including supervision by consultants; (b) paving of 600 km of national highways: Icheon-Judeog, Chungju-Gimcheon, Maepo-Andong, Weonju-Hayeong, Yeongdeog-Uljin, Uljin-Samcheog, Beolgyo-Gangjin, Seongjeon-Mogpo, and Sangju-Gasan, including supervision by consultants; (c) feasibility studies by consultants for improvement and paving of a further 1,200 km of roads, and detailed engineering of those roads found to be justified.

1.02 The Bank Group's previous assistance in financing the transport sector has involved five railway projects: Credits 25-KO for US$14 million in 1962, and 110-KO for US$10.7 million in 1967; Loan 669-KO/Credit 183-KO for US$55 million in 1970; Loan 863-KO for US$40 million in 1972; and Loan 1101-KO for US$100 million in 1975. In addition the Bank Group has financed surveys and studies and two highway projects: a Bank grant of US$200,000 in 1965 for the Korea Transportation Survey; Credit S4-KO for US$3.5 million in 1968 for studies of highways and transport coordination which was refinanced through the First Highway Project, Loan 769-KO for US$54.5 million in 1971; a Second Highway Project, Loan 956-KO for US$47 million in 1974; also a port project, Loan 917-KO for US$80 million in 1973. Performance on these projects has generally been satisfactory.

1.03 For the First Highway Project, construction was completed within the cost estimates, feasibility studies and detailed engineering satisfactorily completed; the highway maintenance study was carried out and on its basis the proposed MOC organization to maintain the national highway system was established in a pilot province and is now being extended to the rest of the country. For the Second Highway Project, construction is nearly completed and feasibility studies were started in July 1975; equipment is being purchased for the new maintenance organization. The Government is taking measures to improve transport planning and coordination, including training of staff.

1.04 The present project has been prepared on the basis of priorities established by the Korea Transportation Survey and the Government's Third Five-Year Development Plan 1972-76. The survey recommended increased investment in transport, with greater emphasis on highways. Feasibility studies and detailed engineering were carried out under Loan 769-KO.

1.05 This report is based on information provided by the Government and consultants, and on the findings of the March/April 1975 appraisal mission, composed of Messrs. P.R. Morris (Engineer) and A.F. Ballereau

(Economist). Preparation of the project was delayed by the need for additional information, which was collected by Mr. Ballereau in July 1975, and by staff constraints. Additional information was also supplied by the Government during negotiations (paras 4.13, 4.16, 4.18 and 4.20).

II. THE TRANSPORT SECTOR

A. Economic Setting

2.01 Korea's economy has registered a rapid expansion in recent years, chiefly through a very high growth rate of its manufacturing and heavy industries oriented to exports but also to import substitution. During 1964-74, the GNP rose in real terms at an average rate of over 10% p.a., but had a succession of peaks and troughs, with a maximum rate of over 16% in 1973 and a minimum of about 6% in 1965. Over that period, exports were rising at an average rate of about 44% p.a. at current prices and represented about 30% of the GNP in 1974. Investment increased from about 11% of the GNP in 1964 to 24% in 1974. The population was estimated at about 34 million in 1974 and its growth rate declined from 2.4% in 1964 to 1.7% in 1974 which contributed to the rise in per capita income to about US$470 in 1974.

2.02 Since late 1973, the sharp world wide inflation, largely resulting from the price increases of oil, foodgrain and some raw materials, badly affected Korea which has few resources and must import most of the commodities needed for its manufactures, including goods for export. Almost simultaneously the deep recession, affecting countries such as the United States and Japan which provide the markets for the bulk of its exports, was directly reflected in Korea's economy and the export growth rate dropped from about 95% in the exceptional year of 1973 to 38% in 1974 at current prices (or from 54% to 9.6% in real terms) which, nevertheless, is only a little below the 1964-74 average. The combined effect of higher import prices and lower growth for exports resulted in the slowing down of the GNP growth rate to 8% in 1974, an increase in the unemployment rate to 4.9% at the end of 1974 (which is probably an underestimate) compared with 4.3% a year earlier, and a general reduction of working hours.

2.03 Although by world standards the performance of the Korean economy has been quite satisfactory, 1974 and 1975 have been difficult years characterized by enlarged balance of payment deficits, a slow down in growth and increased inflation; in 1974 wholesale prices increased by 45% and consumer prices by 26% which called for immediate action from the Government. Measures already taken include devaluing the Won in December 1974, monitoring of prices, reducing imports through higher taxation and customs duties, particularly on fuel and some raw materials, encouraging development of industries aimed at import substitution, and intensifying trade promotion and diversifying overseas markets. Nevertheless, the Government's growth targets for the period 1972-81 which envisaged an 11% p.a. growth of GNP will probably have to be lowered to between 7% and 8%.

B. Transport Modes

Recent Developments

2.04 The transport sector, measured in terms of value added, grew faster than the economy during the past decade and registered an average growth rate of about 16% p.a., compared to just over 10% p.a. for the GNP. The share of transport in the GNP increased from about 3.5% in 1965 to 5.1% in 1974 and over the same period the share of investment devoted to transport grew from 19% to 21% of the total capital formation.

2.05 Domestic passenger traffic (pass-km) and freight (ton-km) for all modes continued to increase by about 14% and 5% p.a. respectively on average, between 1971 and 1975, but the rate of increase was lower and less regular for freight than during the Second Five-Year Development Plan 1967-71. In 1975, public passenger traffic was shared about 74% by highways and about 24% by railways. For freight traffic carried by public carriers, the share was 52% by railways, 23% by highways, and 25% by coastal shipping; however, these figures are somewhat misleading and grossly underestimate the share of highways as private trucking is not accounted for. The annual average traffic growth rate for passengers was 15% for highways and 11% for railways between 1971 and 1975, while freight traffic grew annually by 7.3% for highways, 6.7% for railways and 0.9% for coastal shipping. The Seoul subway which started operation in 1974 is already well used and expected to carry substantially more passengers (Table 1).

2.06 The rapid expansion of transport demand which is directly related to the country's high economic growth rate has imposed a severe strain on the transport infrastructure which up to about 1966 had not been modernized, except for some improvements to the railways. The resulting shortage of capacity caused bottlenecks which have required a massive reorientation of the transport development strategy within the last 10 years, but there are still deficiencies particularly in the highway network. Accordingly, the Government increased the investment in the transport sector and its share of the total public capital expenditure grew from 17% during the First Plan (1962-66) to about 27% during the Second (1967-71) and to about 26% (US$1,000 million) during the Third Plan (1972-76). The allocation between modes is about the same for the last two plans and is reasonable with about 46% for highways, 36% for railways (including the Seoul Subway), 16% for ports, maritime transport and storage and 9% for airports (Table 2).

2.07 As a result of the development of the highway network since 1968, rail/road competition has grown keener, particularly for passenger transport for which highway transport during the last decade progressively increased its share to nearly 75% of all pass-km. Also, the railway is meeting strong competition from trucks for short and medium distance freight traffic because of the flexibility of service and increasing trans-shipment costs from rail to trucks to reach the final destination. Undoubtedly, the virtual monopoly enjoyed by the railway only a decade ago has now ended, and the transport

system is evolving through competition toward a more balanced multi-modal pattern where the different modes will complement each other to some extent, with each specializing according to its technical and economic characteristics.

Highways

2.08 The present highway system is still inadequate to cope with the rapid growth of road transport, despite the Government's effort since 1968 to catch up with the backlog of necessary road improvements. Only 44% of national highways and 19% of other roads are paved, the rest of the network being either gravelled or unsurfaced. This situation will require a continued high level of investment in this subsector. Details are given in Chapter III.

Railways

2.09 The Government owned Korean National Railroad (KNR) at the end of 1973 operated 3,086 route-km of standard gauge, of which 529 km are double track. Electrification of some 321 km of industrial lines from Seoul to the northeast coast (carrying mostly mineral traffic) was completed October 1975. Also about 100 km of suburban lines have been electrified which, with the construction of a subway opened in 1974, constitute the rail transit system in the Seoul area.

2.10 Of the rail freight traffic, over 78% consists of bulk commodities: 38% coal, 15% cement, 8% ore, 7% petroleum products, 6% fertilizer and 4% grain. The railway is expected to retain, or increase, its share of the long distance traffic in line with its increased capacity resulting from operational improvements and additional rolling stock. Continued competition from other modes is expected for the remaining 22% of general freight traffic and for passenger traffic; however, the railway is likely to retain a significant amount of such traffic. The railway is expected to continue to increase its efficiency of operation, partly resulting from Bank financed railway projects, but tariff adjustments will also be required to effect a major improvement in its finances.

Ports and Shipping

2.11 Freight traffic through the ports, including both overseas and coastal shipping, has increased from about 11 million tons in 1965 to 58 million tons in 1973. This sharp increase resulted in serious port capacity problems, particularly at Busan, the largest port, which is chronically congested. Port facilities are being expanded, chiefly at Busan, Incheon, and Mukho, with the help of loans from the Asian Development Bank and the Bank; a new port has been constructed at Pohang by the Government for the steel mill and related steel industries. Korea's share in merchant shipping is increasing slowly but over the last three years only about 22% of the country's total foreign trade tonnage has been carried by Korean vessels. The important role of coastal shipping is largely due to the country's geography and the Government's policy to develop industrial complexes at Pohang, Ulsan, Masan and other coastal sites and to existing shortage of

rail and road capacity. Until 1972 the shipbuilding industry in Korea was only small scale and produced ships in the range of 500 to 5,000 gross tons. However, shipyards have recently been constructed at Ulsan which are now producing supertankers and have an annual capacity of one million gross tons. Another large shipyard is under construction on an island near Busan.

Aviation

2.12 Domestic passenger traffic carried by air is growing rapidly, but still amounts to only about 1% of the total. Domestic air freight traffic is negligible. Domestic routes are served by the privately-owned Korean Airlines (KAL), which also operates a number of international flights. There are two international airports: Seoul, which was expanded recently, and Busan.

C. Transport Planning and Coordination

2.13 In spite of the efforts of the Government since 1970 to create institutions to improve transport planning, the decision-making process for investments is still uncoordinated and dispersed among different Government agencies. The Economic Planning Board (EPB), is the central agency which is intended to have a comprehensive overview of investment in all sectors. However, it has not been able to formulate an investment policy for the whole transport sector at the macro-economic level. Moreover, the EPB does not have the capability to review transport investment proposals by line agencies and to assess the merit of alternative solutions to meet the Government's specific objectives in transport and economic development.

2.14 Upon the recommendations of a study carried out by consultants in 1968 under a Bank Technical Assistance Credit (S4-KO), the Government set up in 1970 a Transport Planning Office (TPO) but located it under the Ministry of Transportation (MOT), whereas the consultants had recommended placing it under the EPB. To control the work of this office, the Government also set up a Transport Coordination Ministers' Conference (TCMC), consisting of the eight Ministers most concerned with transport matters, and a Transport Coordination Working Group, a civil service committee with members from the same Ministries. An action program to improve the working of these bodies was included in the Loan Agreement for the Fourth Railway Project (Loan 863-KO); it comprised undertakings to have the TPO collect data on all transport modes, to have all major investment proposals relating to transport appraised by the TPO before decisions are made, to strengthen the staff of TPO, and to have quarterly reports sent to the Bank.

2.15 The role of the TPO and measures to increase its effectiveness were discussed during negotiations for the Fifth Railway Project. The Government has accordingly, as a condition of effectiveness of the Railway Loan, submitted to the Bank in July 1975 a time-phased program for the effective formulation and review of policies and investment proposals of all its agencies and ministries related to the transport sector, including the role and staffing of TPO. Further, the Government undertook to take

measures within one year, including issuing appropriate decrees acceptable to the Bank, for carrying out the formulation and review of policies and investment proposals in accordance with the program. A transport sector mission will review these matters and examine the general question of road/rail transport competition to ensure closer coordination in future. The first phase of the mission took place in November 1975 and the second and main phase is scheduled for March/April 1976.

III. HIGHWAYS

A. The Network

3.01 The public road network totalling about 44,200 km consists of about 9,300 km of national highways, 10,900 km of provincial highways and 24,000 km of city and county roads (Table 3). The national highways include about 640 km of grade separated toll expressways, of which about 500 km are four-lane divided, and 140 km are two-lane. The average road density is 0.5 km of road/km^2 of land area, and 1.3 km of road/1,000 inhabitants. These compare with ratios of 0.1 km of road/km^2 and 1.3 km of road/1,000 inhabitants in Thailand and 0.2 km of road/km^2 and 1.7 km of road/1,000 inhabitants in the Philippines.

3.02 The road density is generally sufficient to serve transport needs, particularly as around 70% of the total land area is mountainous, but the condition of most of the road network is inadequate. Only 44% of the national highway system is paved, and 6% of the provincial highways (compared with over 85% and 35% in Thailand respectively). Further, the unpaved roads are in a poor state. Average driving speeds are usually only in the range of 25-35 kph because the roads are badly aligned, narrow, and have poor drainage and rough gravel surfacing, and a few are unsurfaced. There is thus an urgent need to improve the highway network, particularly: (i) major reconstruction and realignment of a few major trunk routes; (ii) the paving of virtually all remaining national highways, and those provincial highways with high traffic volumes; (iii) improvement of the condition of gravelled and unsurfaced roads, chiefly through improved maintenance; and (iv) instituting an adequate system of maintaining paved highways.

B. Highway Traffic

3.03 Between 1964 and 1974, the motor vehicle fleet grew from about 38,000 to 184,000 an average increase of 17% p.a. (Table 4). However, during the last six years, the growth rate has fluctuated widely. Between 1967 and 1971, it accelerated to an average of 24%, whereas in 1971 it fell to about 12% and in 1972 to 4%. It was up again in 1973 to 14% and down in 1974 with a growth of about 7%. Furthermore, the highest increase

from 1971 to 1973 was in two-wheeled vehicles and, if these were excluded, the growth rate would have been much less. The vehicle fleet is still small; it is only 1 vehicle per 185 inhabitants, compared with 1 to under 50 inhabitants in Thailand, and 1 per 70 in the Philippines.

3.04 In line with the Government's policy of developing a domestic motor vehicle manufacturing industry, local production increased from about 2,000 in 1962 to 30,000 in 1970; but since then production fell gradually to about 18,000 in 1972 and rose again to 30,000 in 1974 and is expected to reach 49,000 in 1975 (Table 5). This growth was fostered by restrictive import licensing and high customs duties on foreign assembled vehicles. As a result, nearly all motor vehicles are locally assembled, and with an increasing proportion of locally manufactured parts. The Government now hopes also to build up an export trade in vehicles, and the aim is to produce 140,000 vehicles p.a. by 1980, a much lower target than their earlier forecast of mid 1973 of 500,000 vehicles by 1980. There are four local manufacturing/assembly plants, with joint participation by Korean firms with General Motors, Ford, Fiat and Honda. The combined capacity in 1974 was about 90,000 vehicles p.a., on the basis of a single shift. Present production is thus only about one third of capacity. The local content is about 80% for buses and trucks, and about 70% for cars. The three largest manufacturers have factories to produce engines and plan to export a large proportion of the engines produced. Production of commercial vehicles represents over 70% of total output, with about 57% trucks and 13% buses; light vehicles (mainly taxis and pick-ups) are less than 30%. However, Hyundai is about to manufacture a 100% Korean car, designed by an Italian firm, intended primarily for export, with 1000 units in 1976, increasing to 40,000 by 1980.

3.05 Passenger traffic on highways (pass-km) accounts for about 74% of the total for all modes (Table 1). The growth rate for highway passenger traffic in 1967-71 averaged about 18% p.a. and in 1971-75 about 15% p.a. Highways are expected to continue to take all the increase in inter-city traffic, but the growth of urban passenger traffic is expected to be shared with the railway, particularly the new subway and electrified suburban lines in the Seoul area. Freight traffic on highways (ton-km) represents about 23% of such traffic on all modes, but the growth of road freight in 1967-71 averaged 49% p.a. which was more than double the average (19%) for all freight traffic. Road freight traffic grew at only 7% in 1971-75 but that was still above the average for all modes (5%). The share of freight traffic by road is expected to continue to increase in the long term, but at a reducing rate. However, since 1971, there has been a sharp fall in the growth of road traffic, as indicated by a growth in 1972 of only 4% in registered vehicles (para 3.03), and 7% in fuel consumption (gasoline and diesel). The trend to slower growth of fuel consumption has been further accentuated since the oil crisis of late 1973 (Table 6).

3.06 The Government attributes the fall in growth of road vehicles and traffic since 1971 first to the economic stabilization policy and the consequent reduction in the growth rate of GNP from 15% in 1969 to 7% in

1972 and more recently to the large increase in oil prices. However, restrictive licensing of commercial vehicles is also believed to have significantly affected growth. Such restrictions included (a) issuing licenses only to enterprises having a minimum of 20 vehicles in cities or 10 vehicles in country districts; (b) imposing quotas on total numbers of vehicles in each province; (c) regulation of rates for freight, as well as for passenger traffic. In addition, the cost of vehicles is high as a result of the Government's policy of prohibiting the import of all assembled vehicles (except a small number, in special categories) and requirements that an increasing proportion of domestically manufactured components be used in locally assembled vehicles. The resulting high unit costs, with small production volumes, may have limited potential demand for vehicles.

3.07 The Government in line with the Loan Agreement for the Second Highway Project undertook to review its policies concerning the regulation of road transport and is relaxing the restrictions described in para 3.06. Taking into account the economic recession and GNP growth rate forecast of about 7% p.a. in 1975, the Government expects an annual increase of registered vehicles of around 16% p.a. from 1975 through 1981. However, even with the removal of restrictions, the Government's projections of the growth of the vehicle fleet appear optimistic. Lower growth rates have therefore been assumed in the economic analyses of the proposed project.

3.08 Traffic counts on the national highways have been made since 1965 by the Ministry of Construction (MOC), assisted by the provincial authorities, and are now carried out twice a year. Their reliability has been improved, and they are now used in planning highway improvements. In accordance with the Agreement for the Second Highway Project (Loan 956-KO), a start was made in 1973 to extend the counting, recording and analysis of traffic data to the provincial highway system. During negotiations the Government confirmed that it will continue the collection and analysis of traffic data on national highways, and complete the extension of traffic counting to the provincial highway system.

3.09 Current regulations on vehicle weights and dimensions were reviewed by BCEOM as part of the maintenance study carried out under the First Highway Project. This showed that the existing legal limits are reasonable, including a 10-ton single axle load, but that they should be extended to cover semi-trailers and trailer combinations. A 35-ton limit was proposed for all vehicles, and a 16-ton limit for tandem axles. The Government is amending the regulations accordingly, as called for under the Second Highway Loan Agreement.

C. Highway Administration

3.10 The MOC (Chart 1) is responsible, through its Bureau of Public Roads (BPR) (Chart 2) for the planning, design, construction, maintenance and administration of national highways. Local roads, which include provincial, special city (Seoul and Busan), city and county roads, are the

responsibility of the local authorities, under the Ministry of Home Affairs (MOHA) (Table 7). However, the MOC has a general responsibility to the Government for the formulation of policy in relation to these local roads.

3.11 The present organizations for planning, designing and constructing highways, with the assistance of consultants and contractors on major works, are satisfactory, the main organizational weakness being in highway maintenance. Historically, responsibility for maintaining all highways rested with the provinces and their local authorities. In January 1971, the MOC was given responsibility for maintaining national highways but, as the MOC did not have a field organization to carry out the work, it continued to be performed by the provinces with grant assistance. This imposes a burden which the provincial authorities are not able to cope with adequately, in addition to maintaining their local roads; over half their resources are presently devoted to the national highways. To improve the situation, the Government is setting up a new MOC field organization.(paras 3.22 - 3.25).

3.12 The Korea Highway Corporation (KHC) was set up by the Government in January 1969 to construct, operate and maintain toll highways. It is semi-autonomous, with its own Board of Directors, budget and accounts, but is subject to the general direction of the Minister of Construction. The KHC presently operates 640 km of toll expressways (Seoul-Busan, Seoul-Incheon, Suwon-Weonju-Saemal, and Daejon-Jeonju). It supervised construction of the last two, but so far has not financed any construction, although its Articles of Association permit this. During negotiations the Government agreed to prepare and submit to the Bank for review a policy statement relating to the Government's toll road system including the functions, responsibilities and budget of KHC.

3.13 The BPR is the headquarters organization within the MOC dealing with the planning, administration, construction and maintenance of national highways. Design and construction of national highways are normally carried out by the Territorial Construction and Management Offices (TCMOs); the number of such offices (previously known as Regional Construction Bureaus) was expanded in mid 1975 from five to nine. The TCMOs also carry out construction for other Bureaus of the MOC (on ports, water resources, housing etc.). The design of major highway projects, particularly those financed by international agencies, is carried out with the assistance of consultants, working directly under the BPR; the supervision of their construction is usually carried out by the TCMOs and the KHC working under the technical direction of the BPR.

3.14 The provinces through Provincial Construction Bureaus (PCBs) are responsible for the construction, maintenance, and administration of the provincial highway system. The local authorities, that is counties and cities, are responsible for local roads. Two Special Cities, Seoul and Busan (with City Construction Sections), are responsible for all roads within their areas.

D. Highway Planning and Financing

3.15 Planning of the national system is the responsibility of the MOC and is carried out by its BPR, which has a Planning Division. The Division carries out traffic surveys and maintains an inventory of national highways. The data for the inventory, hitherto provided by the provinces, have not always been reliable, but this will be remedied when the new MOC maintenance organization has been established over the whole country and takes over data collection. A revised and satisfactory inventory has already been prepared by the new MOC maintenance organization set up in a pilot province. The BPR drafts the Five-Year Development Programs and Annual Budgets for development. The drafts are reviewed by the MOC and revised in consultation with the EPB and Ministry of Finance (MOF) and finally incorporated into the National Five-Year Economic Development Plans and Annual Budgets. In reviewing the drafts, the aim is to make the programs consistent with the national development and financial targets established by the EPB and the MOF. The BPR is also responsible for giving technical advice on all highway matters to the Government, including the MOHA and the provinces; it reviews proposals originating from these bodies for road improvements and grants for maintenance. Planning of provincial roads is the responsibility of the provinces, and city and county roads are planned by the local authorities concerned.

3.16 The Government originally planned to spend a total of Won 227 billion at 1970 prices on highways under the Third Five-Year Economic Plan (1972-76) but this has been revised to Won 268 billion (US$554 million) at current prices. This amount includes about Won 192 billion for national highways and Won 36 billion for provincial and local roads. Because of cost increases, the target for national highways was scaled down to 500 km from 1,000 km for new construction or major reconstruction including realignments, and to about 3,000 km from 4,000 km for paving, including minor improvements. For provincial roads, the target remains, for the present, to pave and improve a total of about 3,500 km. Original targets proved optimistic since unit costs are exceeding those used in the plan; also the time required to prepare and execute projects may have been underestimated. However, the revised allocation of Won 268 billion is likely to be substantially spent. This compares with Won 123 billion in the Second Five-Year Development Plan (1967-71) (Table 2), but although almost double at current prices, it probably will represent little increase at constant prices. The physical targets are reasonable in relation to: (a) the present condition of the national, provincial and local road networks (para 3.02); (b) the current level of traffic on national highways (para 3.05); and (c) the probable increases in traffic to meet transport demand (para 3.07).

3.17 Data on expenditures on provincial and local roads are incomplete from 1972 (Table 8), but it appears that expenditures on roads in recent years have been much lower than revenue from road user charges (Table 9). Budgetary provision for each year is based on the estimated road user charges. These exclude import duties, but include: (i) 75% of the gasoline and diesel tax and 100% of the transport tax levied on public passenger traffic

on roads (these items accrue to the Government highway budget); and (ii) the vehicle tax, vehicle acquisition tax and registration fees (which accrue to the highways budgets of the provinces, cities and counties). Total taxation on motor vehicles is rather high for a developing country. In particular, the taxes on vehicle acquisition and ownership are high and the Government is considering gradually reducing these taxes but has recently increased taxes on vehicle use, particularly increasing the taxes on gasoline and diesel fuel.

E. Highway Design and Construction

3.18 The responsibilities for the design and construction of various classes of roads are shown in Table 7. The BPR is responsible for design and supervision of construction of national highways, and for establishing standards for other Government-financed roadworks and for reviewing proposals submitted by provinces and local authorities. In the case of major construction projects, consultants are usually employed for design and to assist with supervision, particularly when financed by international agencies; the Government's supervisory duties are now normally exercised through the TCMOs of the MOC, but in a few cases they are delegated to the KHC. Other works on national highways are designed and supervised by the TCMOs, sometimes with the assistance of consultants, and under the general direction of the BPR. The KHC was responsible for design (under the technical direction of the BPR) of toll expressways; it also supervised their construction. The BPR has prepared design standards for national highways (Table 10). These are divided into two parts, one for new construction, or major reconstruction with substantial realignment, while alternative standards have been devised for paving of existing highways with minimum realignment and improvement. Both sets of standards are reasonable for their purposes.

3.19 Many sections of gravel-surfaced national highways are carrying traffic volumes beyond their capacity. In some cases, the traffic levels, together with the scope for improving and shortening the alignment, justify new construction. For the remainder, the MOC has prepared an extensive paving program with minimum realignment and improvement. The consultants BCEOM (France) assisted in preparing the paving program as part of the Highway Maintenance Study carried out under the First Highway Project, Loan 769-KO. Also under Loan 769-KO, and as part of this paving program, BCEOM, in association with three Korean firms, studied and engineered highways totalling about 634 km and these are being paved, including widening and improvement, under the Second Highway Project, Loan 956-KO. Also under the First Highway Project, the MOC has had another slice of the paving program prepared by consultants Wilbur Smith and Louis Berger (both US) and Kampsax (Denmark), in association with seven Korean firms; the paving of these nine highways, totalling 601 km, is included in the proposed project. Further, under the Second Highway Project, the MOC has employed Louis Berger, in association with eight Korean firms, to study and engineer a further slice

of the paving program for national roads as well as several high priority provincial roads.

3.20 Virtually all construction and paving is carried out by contracts which are awarded after competitive bidding. This has provided a large and increasing volume of work and forms the basis for the Government's successful policy of promoting the growth of the domestic contracting industry. Further assistance in the initial stages was provided through Government loans on favorable terms to contracting firms for the purchase of equipment. There is now a well established and efficient domestic contracting industry, with about 750 firms, including several large ones which undertake works overseas as well as in Korea. Foreign contractors have had little success, because of price competition, in obtaining civil engineering work in Korea, though a number of firms have expressed interest in bidding. Some minor construction is undertaken by force account by the TCMOs, PCBs, and City and County Construction Sections. The army is responsible for roadworks in the northern border area.

3.21 The choice of construction methods is left to the contractors, subject to complying with performance specifications. The Government does not impose any conditions or incentives to influence the relative use of equipment or labor. The larger works, because of the nature of the operations, tend to be carried out predominantly with equipment. On the other hand the smaller local authorities, particularly counties, tend to use a greater proportion of labor on their force account works because they have only a very limited amount of equipment and much of the work is of a nature which can be fairly easily adapted to hand methods. For example, many small access roads are being constructed and improved through local community effort (the Saemaeul movement) and Bank assistance with this work is being considered as part of the proposed Rural Infrastructure Project.

F. Highway Maintenance

3.22 Although there has been some improvement in recent years, the maintenance of highways is still unsatisfactory. The maintenance agencies (Table 7) have inadequate staff, equipment and finances to maintain the national, provincial and local road systems. Except for the expressways, the existing paved roads are not being promptly repaired, nor are their surfaces renewed periodically on a systematic basis as required to prevent further deterioration and eventual collapse. The majority of the roads, which are gravel surfaced, are incorrectly shaped and inadequately drained. These conditions, combined with relatively high traffic volumes, causes the road system, including the national highways, to be in poor condition and road transport costs are unnecessarily high.

3.23 The MOC therefore had the consultants BCEOM (France) carry out a Highway Maintenance Study under the First Highway Project. Their plan, which was accepted by the Government, was for a new field organization to

be set up, within the MOC, to maintain national highways. The provincial and local authorities will then be relieved of all work on national highways, which presently absorbs over 60% of their entire financial and other resources devoted to roads; they will thus have the capacity to maintain provincial and local roads at a satisfactory level. As the first stage of the BCEOM plan, the MOC established in September 1972 its new maintenance organization in a pilot province; it consisted of two field sections (districts) which were recently renamed National Highway Maintenance Offices (NHMOs), with equipment financed under the First Highway Project. The second stage of the BCEOM plan, which was also accepted by the Government, covers the extension of the MOC field organization to the remaining eight provinces. This entails setting up of a further 17 NHMOs, making a total of 19, to cover the entire national highway network. Each will have a depot, with an office, workshop and equipment.

3.24 Under the Agreement for the Second Highway Project, Loan 956-KO, the Government undertook to complete the establishment of the MOC nation-wide highway maintenance organization in accordance with an agreed program, with equipment to be financed under that project. However, there were administrative delays in drafting and approving the decrees authorizing the new organization and they were published June 18, 1975 instead of June 30, 1974. Nevertheless the Government is now pressing ahead with the installation of the new organization under a revised implementation schedule which was proposed by the Government and accepted by the Bank (Table 11). This indicates that the depots, workshops and other installations are expected to be completed by March 1, 1976, and that the organization will be fully staffed and equipped and will have completed taking over the maintenance of national highways by October 1, 1976.

3.25 Arrangements have been made to obtain the staff required, partly by transfers from other parts of the MOC, and partly by recruitment, and for their training through courses conducted by the Ministry's Training Center, and by attachment, in rotation, to the two field sections operating in the pilot province. Starting in 1973, the overseas training program financed under the First Highway Project is training a total of eleven of the staff of the MOC and MOT: five in transport economics, one in traffic engineering, one in highway engineering and four in highway maintenance. The courses for all trainees are in progress except in transport economics where two have been completed and two are expected to start shortly. BCEOM are continuing to provide technical assistance, as an extention of the maintenance study. During loan negotiations assurances were obtained from the Government (reiterating the undertakings given in the Agreement for Loan 956-KO, Section 3.12) that it will: (i) cause the National Highway Network to be adequately maintained, and will make adequate arrangements satisfactory to the Bank for the timely provision of funds and resources required for that purpose; and (ii) establish the MOC field organization in accordance with the revised schedule (Table 11).

IV. THE PROJECT

A. Description

4.01 The object of the project is to assist in improving the highway system to meet the growing traffic by extending the network of all weather paved highways between the main centers of population by nearly 800 km and, through studies and engineering, prepare future improvement projects.

4.02 The project consists of:

(a) construction, chiefly on new alignments, including paving, of about 195 km of four national highways, including supervision of the work by consultants;

(b) paving and improvement, chiefly on present alignments, of nine national highways totalling about 600 km, including supervision of the work by consultants; and

(c) feasibility studies by consultants of about 1,200 km of national and provincial roads, to be followed by detailed engineering if found justified.

(a) Construction

4.03 Four sections of national highways totalling about 195 km, described in Annex A, will be constructed, chiefly on new alignments, with two-lane pavements:

(i) Seoul (Seongnam)-Icheon (43 km);

(ii) Daegu-Masan (85 km);

(iii) Pohang-Yeongdeog (45 km); and

(iv) Sumcheon-Beolgyo (22 km).

The existing roads are rough, narrow, poorly aligned, and unpaved except for a few sections in or near the main towns. In each case it was found that reconstruction mainly on new alignment was justified in view of the nature of the present road, the scope for improving the alignment, and the present and expected future traffic volumes. The new roads are designed to "construction" standards (Table 10, Part A). Present average travel speeds are generally around 30 to 35 km/h, while the new alignments are based on design speeds of 100 km/h in rolling terrain, and 70 km/h in hilly terrain, though a few short sections in mountainous areas have a design speed of 50 km/h. The pavement width is 7.20 m.

4.04 Feasibility studies were carried out in 1972-73, by consultants Wilbur Smith and Associates (US) for roads (i) and (ii), and by Louis Berger (US) in association with Kampsax (Denmark) on roads (iii) and (iv). Detailed engineering of all four roads was carried out between late 1973 and 1974 by Wilbur Smith and Associates in association with Louis Berger and Kampsax, assisted by seven local firms for topographical surveys and soils and materials investigations. The feasibility studies and engineering were financed under the First Highway Project Loan 769-KO.

(b) Paving

4.05 Nine sections of national highways, totalling about 600 km described in Annex 2, will be paved with two-lane width, mainly on their present alignments, but with improvement of curves and widening of the roadway and shoulders. The roads are:

(i) Icheon-Judeog (53 km);

(ii) [illegible] (10[illegible] km);

(iii) Maepo-Andong (87 km);

(iv) Weonju-Hayeong (40 km);

(v) Yeongdeog-Uljin (76 km);

(vi) Uljin-Samcheog (71 km);

(vii) Beolgyo-Gangjin (67 km);

(viii) Seongjeon-Mogpo (40 km); and

(ix) Sangju-Gasan (64 km).

In addition to paving, the road level will be raised and ditches and culverts constructed to improve drainage, and existing bridges widened or reconstructed, or new ones constructed were necessary. The pavement width will vary, according to traffic levels, from 6 m to 7 m and shoulder widths from 0.65 m to 2 m.

4.06 Feasibility studies and detailed engineering of the roads were carried out under the First Highway Project Loan 769-KO. Feasibility studies of roads (i)--(iv), and (ix) were carried out by Wilbur Smith and Associates, and feasibility studies of roads (v)--(viii) were carried out by Louis Berger, in association with Kampsax. Detailed engineering of all the roads was carried out, as for the new construction (para 4.04), by Wilbur Smith Associates in association with Louis Berger and Kampsax, assisted by seven local firms.

(c) Supervision of Construction and Paving

4.07 The Government intends to have supervision of construction of the Daegu-Masan highway (para 4.03) carried out jointly by the Korea Highway Corporation (KHC) and the design consultants Wilbur Smith and Associates, in association with Louis Berger and Kampsax. This is similar to the arrangement for supervising construction under the Second Highway Project (for which Ingeroute were the consultants) which has worked well. Most of the field staff are provided by KHC, but a small number of personnel provided by the consultants enables them to exercise over-all control in interpreting the designs and specifications, including suggesting amendments as found necessary during construction, and has produced good quality work.

4.08 The Government intends to have supervision of construction of the remaining three highways (para 4.03) and of paving of the nine highways (para 4.05) carried out jointly by the new Territorial Construction and Management Offices (TCMOs) and the design consultants Wilbur Smith and Associates in association with Louis Berger and Kampsax. The TCMOs will provide most of the field staff, but the design consultants will supply the minimum number of staff needed to insure proper interpretation, and variation, of designs and specifications, as well as to back up the rather new and untried TCMOs in insuring adequate quality of the works carried out by the contractors. The Government confirmed during negotiations that consultants acceptable to the Bank will be employed for supervision, under terms of reference and conditions satisfactory to the Bank, and that no contract will be awarded for construction or paving until the supervision consultants have been appointed.

(d) Feasibility Studies and Detailed Engineering

4.09 The project includes feasibility studies by consultants, to be followed by detailed engineering if found justified, of about 1,200 km of roads for future projects. The Government has selected a tentative list of roads, but this is still being reviewed and will be subject to later agreement with the Bank. They are expected to consist mainly of national highways, though the Government is reviewing the provincial road network to screen out high priority sections for inclusion in the study. Both national and provincial roads selected would be among the higher priority roads to be included in the Fourth Five-Year Development Plan to start in 1977. It was confirmed during loan negotiations that the Government will: (i) employ qualified and experienced consultants acceptable to the Bank, and on terms and conditions satisfactory to the Bank, for carrying out the feasibility studies and detailed engineering; (ii) select roads for the feasibility studies, and sections for subsequent detailed engineering, in agreement with the Bank; and (iii) will not carry out any works other than maintenance or minor improvements on the highways selected for studies and engineering without first consulting the Bank.

B. Cost Estimates and Foreign Exchange Component

4.10 The total cost of the project, including contingencies allowances, is estimated at about US$220 million equivalent, with a foreign exchange

component estimated at about US$90 million, or 41%. The estimated costs are shown in Table 12, and are summarized below. The estimated average costs per km, excluding contingency allowances (including contingency allowances shown in parentheses) are: (a) for construction US$379,000 (US$449,000); (b) for paving US$120,000 (US$142,000); (c) for supervision by consultants US$10,050 (US$11,900); and (d) for feasibility studies and detailed engineering by consultants, for construction, improvement and paving US$2,750 (US$3,250).

Project Element	Won (million)			US$ (million)			% Foreign Exchange Component
	Local	Foreign	Total	Local	Foreign	Total	
A. Construction of four Highways	19,726	16,139	35,865	40.6	33.3	73.9	45
B. Paving of nine Highways	19,200	15,710	34,910	39.6	32.4	72.0	45
Subtotal A & B	38,926	31,849	70,775	80.2	65.7	145.9	45
C. Consulting Services:							
(a) Supervision A & B	2,716	1,164	3,880	5.6	2.4	8.0	30
(b) Feasibility Studies & Detailed Engineering	1,115	485	1,600	2.3	1.0	3.3	30
Subtotal C	3,831	1,649	5,480	7.9	3.4	11.3	30
D. Contingency Allowances:							
(a) Physical /a	4,275	3,350	7,625	8.8	6.9	15.7	
(b) Price /b	8,640	6,780	15,420	17.8	14.0	31.8	
Subtotal D	12,915	10,130	23,045	26.6	20.9	47.5	
Total Cost of Works	55,672	43,628	99,300	114.7	90.0	204.7	44
E. Right of Way	7,760	—	7,760	16.0	—	16.0	
Total Project Cost	63,432	43,628	107,060	130.7	90.0	220.7	41

/a 10% on all items.

/b Price escalation assumed to be at the annual rates of 12% in 1976, and 10% in 1977 and each year thereafter, for both foreign and local costs.

4.11 Cost estimates for construction of the four highway sections (para 4.03), and for paving of the nine sections of highways (para 4.05) were prepared by Wilbur Smith/Louis Berger/Kampsax on the basis of detailed bills of quantities after completing detailed engineering, using the unit prices for similar work obtained from competitive bidding in late 1973 and early 1974 on the Second Highway Project, adjusted to cover increases in costs estimated to March 1976, when bids are scheduled to be received.

4.12 The cost estimates for consulting services for supervision of construction and paving, and for feasibility studies and detailed engineering of further highways, are based on previous contracts with consultants for similar work, with costs updated to cover increases estimated to late 1976. The foreign exchange costs are relatively low because of the large and increasing proportion of Koreans employed on the work.

4.13 Contingency allowances include 10% for physical quantities of work to be carried out, and for price escalation at average annual rates of 12% in 1976, and 10% during each year thereafter both for foreign and local costs. The cost estimates and contingency allowances are considered reasonable, and during loan negotiations they were reviewed and agreed with the Government.

4.14 The consultants estimate the foreign exchange component of the highway construction and paving works at about 45% if carried out by local contractors. Under both the First and Second Highway Projects, all contracts have been won by local firms. It is likely that all contracts under the proposed project will also be won by local contractors, and the foreign exchange component for construction and paving has therefore been calculated at 45%. This is higher than estimated under the First Highway Project (40%) and Second Highway Project (35%), chiefly because of the greater proportionate increase in import prices of petroleum and petroleum products (which have more than quadrupled) and other imported materials and equipment compared with domestic prices. The foreign exchange component of the consulting services is estimated at 30%, based on experience in recent contracts with consulting firms, and the probable proportions of foreign and Korean staff to be employed.

C. Financing

4.15 The total cost of the project is estimated at about US$220 million; the foreign exchange costs, to be financed by the loan, are about US$90 million, and local costs about US$130 million (Table 12). The Government has provided promptly the funds needed for expenditures under the First and Second Highway Projects, and it was confirmed during loan negotiations that it will make timely provision for funds required to carry out the project. Furthermore the Government has requested a loan of US$35 million from the Saudi Fund for Development.

D. Implementation

4.16 The MOC will be responsible for carrying out the project, through its BPR, as in the case of the First and Second Highway Projects. Consultants will assist in supervising the construction and paving of highways, and in carrying out feasibility studies and detailed engineering for future projects. During negotiations, agreement in principle was reached with the Government on the terms of the proposed agreement between MOC and KHC for supervision of construction of the Daegu-Masan highway (para 4.07), compatible with preserving the responsibilities of the consultants.

4.17 All highway construction and paving will be carried out through contracts awarded on the basis of international competitive bidding by pre-qualified firms, in accordance with the Bank Groups "Guidelines for Procurement", and on the advice of the consultants. The Government has already advertised internationally in accordance with the guidelines, and assurances were obtained during negotiations that the Government will follow the Bank procedures for procurement.

4.18 Contractors may choose their own construction methods, subject to the works complying with the specifications, and make their own judgments as to the optimum use of equipment and labor. The contracts for construction and paving are expected to be awarded during the first half of 1976 and to take about three years. The feasibility studies are expected to be started in the second half of 1976, and detailed engineering to be carried out in 1978. The works are expected to be completed during the first half of 1979. Allowing for making final payments, and completing disbursements, the closing date for the loan will be December 31, 1979. During negotiations, agreement was reached with the Government on a schedule for project execution (Table 13) and on arrangements for reporting progress.

4.19 The project is not expected to have any significant adverse ecological effects. The works have been designed to provide adequately for drainage, and to avoid erosion. Location of alignments for new construction has, as far as possible, avoided buildings and rice paddies or other intensively cultivated land; the alignments of the highways to be paved largerly follow the existing roads, minimizing the additional right-of-way required, and therefore the disturbance to property. Although acquisition of the right-of-way has not posed any significant problem on previous highway projects, confirmation was obtained during negotiations that such acquisition will be completed on each highway section before a contract for construction or paving of the section is awarded.

E. Disbursements

4.20 Disbursements from the Loan will be on the basis of: (i) 45% of the total cost of construction and paving; (ii) 100% of the foreign exchange cost of the consultants' services. On that basis, and on the schedule for

execution of the project (para 4.18), a Schedule of Estimated Disbursements has been prepared (Table 14); this was reviewed and agreed with the Government during negotiations.

V. ECONOMIC EVALUATION

A. General

5.01 The Third Highway Project will continue Bank assistance to Korea in improving and modernizing the road transport system. The benefits accruing from the project are essentially a reduction of unnecessary high costs of moving goods and people and provision of easier access to some isolated areas with high economic development potential. The project will help to cope with the present and planned growth of the transport demand of this fast growing, export-oriented economy and assist the Government's policy for decentralizing industry. The demand for road transport registered in recent years the highest increase of all modes for freight and passengers, in spite of a severe but apparently temporary slowdown affecting each year since 1971 with the exception of 1973 (paras 3.03 to 3.07).

5.02 The highway construction (195 km) and paving (600 km) elements of the project will help the Government's efforts to achieve targets for the construction of about 500 km of national highways and the paving and improvement of another 3,000 km including provincial roads, during the Third Five-Year Development Plan (1972-76). The project also provides for further feasibility and detailed engineering studies for the improvement and paving of about 1,200 km of road in preparation of a possible future project.

5.03 This project supports the Government's present strategy in the 1972-76 Plan of giving emphasis to the paving of existing gravel roads, which still account for over half of the national network, rather than concentrating chiefly on the construction of new high-standard highways. Feasibility studies of roads have shown that for most sections, at the present time, the optimum first stage of improvement is to pave the road largely on the present alignment, with only minimum improvement of sharp curves, etc., and widening and improvements of drainage. The lower cost of such work permits the paving of two or three times the length of road which could be newly constructed. However, there are some sections where factors, including the traffic volumes, inadequacy of present alignments, possibility of substantial shortening of the routes, etc., justify immediate construction on new alignments. The present approach of minimizing and phasing investments, increases the feasibility of road projects and enables the highway system to meet a much larger total transport demand at lower cost; it follows the recommendations of the consultants and of the Bank.

5.04 The economic analysis of the project roads, carried out by two separate teams of consultants, Wilbur Smith (US) and Louis Berger/Kampsax (US/Denmark) in Feasibility Studies completed in mid 1973, was up-dated in

the detailed engineering study carried out jointly by the above firms and completed early 1975. The economic setting and the present traffic volumes of the roads for construction and for paving are described in Annexes 1 and 2. The consultants' estimated traffic assignment, expected volumes and growth rates (Tables 15 and 16) are based on regular MOC counts between 1965 and 1971 and on the MOC's last detailed traffic origin and destination survey conducted in 1969. The consultants supplemented those counts with special counts performed in June 1972 which was taken as the base year. However, due to the major changes related to the increases of prices of imported oil and raw materials which affected the Korean economy since the publication of the original feasibility studies, supplementary counts were made in May 1974. Figures were adjusted in line with prevailing growth rates to produce the 1975 traffic data.

5.05 The expected growth rates of normal traffic, averaged for all vehicles, vary from 8.2% to 9.9% p.a. among the project roads, based not only on past traffic growth, but on past and expected increases of the GNP, on population forecasts, and on regional per capita income. The rates were adjusted to take into account the recent slow-down in the rates of increase in the production and registration of vehicles and of gasoline consumption (Tables 4, 5 and 6) but took into account that vehicle licensing regulations would be relaxed (paras 3.03 to 3.07). The generated or induced traffic is expected to increase total traffic by amounts ranging from 9.2% to 30.2% among the project roads. These increases are derived from studies of earlier cases where the elasticity of demand of road transport as a function of the reduction of operating costs was measured. The rates were adjusted to take account of development potential of industries such as fishing, timber, tourism or other activities. Traffic diversion from other roads will occur for seven of the eleven project roads, but will be significant only for Seoul (Seongnam) - Icheon (1240 aadt) and Daegu-Masan (744 aadt). Minor traffic diversion from rail on six roads may occur but is expected to account for only a small amount of the predicted road traffic. The greatest diversion is expected on Seoul (Seongnam) - Icheon, but even there is likely to be only 125 load vehicles/day, or about 6% of total traffic on the road. On the other five roads, the diversion from rail will represent even smaller amounts of road traffic, varying between 17 and 68 vehicles/day.

B. Highway Construction

5.06 The four road sections for construction (Annex 1) are scattered throughout the country but are located mostly in the immediate influence areas of fast growing cities such as Seoul, Daegu, Masan and Pohang. The Seoul (Seongnam)-Icheon Highway (43 km) will provide a new access to Seoul and so help to reduce traffic congestion on roads on the south side of the city; it will also aid the planned expansion of the Seoul metropolitan area toward the south-east. Also the road with its new alignment and tunnel will substantially shorten (by 23 km) the distance between Seoul and Icheon compared to the alternative road which deviates around the north of

a mountain range. Considerable diversion of traffic to the new road is expected from the old road and from Seoul-Icheon traffic presently using a still longer route via the Seoul-Singal and Singal-Icheon sections of the Seoul-Busan and Singal-Wonju expressways.

5.07 Similarly the Daegu-Masan highway (85 km) will help to reduce congestion on the present road accesses to Daegu by adding a new access which will also act as a beltway for the west side of the city. The road will serve the growing existing local and through traffic between Daegu and Masan. It will also attract a considerable amount of traffic now travelling between Daegu and the Masan-Busan area via the longer alternative route through Busan, using the Seoul-Busan toll expressway and the Busan-Masan Section of Jeonju-Busan highway. The longer alternative is chosen now for many journeys because of savings in journey time and comfort, compared to the existing Daegu-Masan road which is poorly designed and rough surfaced. The economic evaluation shows that the expensive new Daegu-Masan highway is largely justified by the substantial diversion of traffic described above.

5.08 The Pohang-Yeongdeog highway (45 km) serves an isolated area of the east coast. The existing poor gravel road is the only access as the railway line started during the Japanese occupation was never completed. This north-south corridor between the mountains and the sea has considerable potential for agriculture, fisheries, forestry and tourism and recreation along the scenic sea shore, but these resources are under-developed. The recent introduction of the steel industry and related activities in Pohang (population 120,000) has contributed to the increase in transport demand in the area.

5.09 The Suncheon-Beolgyo highway (22 km) in the south-east serves an essentially agricultural area, producing rice and vegetables, mainly tomatoes in numerous greenhouses, and fish in the coastal villages. The new and improved alignment will eliminate seven railway crossings which presently increase the hazards for traffic on the existing winding road.

5.10 The benefits from the proposed construction of those four roads were determined as the difference or savings in road user costs with and without the project, for the normal and diverted traffic and for part of the generated traffic; benefits also comprise travel time savings but these are restricted to working time, and reduction in road maintenance costs. The average vehicle operating costs for each road are given in Table 16 and were assessed for typical vehicles; savings on the new roads range between 36% to 61% for cars, 42% to 55% for buses and 46% to 54% for trucks, taking into account road standards, traffic density, speed and side friction. The savings in working time for light vehicles were quantified on the basis of 545 Won/hr per average car which comprises 60% taxis, 20 to 25% Government cars and 15 to 20% private cars. Working time savings were quantified only for the driver and helpers of buses and trucks and were valued at 504 Won/h per bus and 399 Won/h per truck. Benefits from reduction of accidents were also quantified but are not significant.

5.11 The streams of costs and benefits are shown in detail in Table 18. Economic returns (ERs) for each road, calculated over an assumed 20 years service life of the investment, vary between 21% and 37%. The sensitivity of the ERs was tested by varying construction costs by ± 15% and benefits by ± 25%. Under the pessimistic assumption of an increase in construction cost concurrent with a decrease in benefits, the ERs would be between 14% and 28% (Table 20). Exclusion of passenger time savings would reduce the above returns by about two percentage points. Thus, the highway construction element of the project is amply justified. The traffic forecasts and economic evaluation of the roads, both for construction and for paving, have been based on the assumption that tolls will not be levied on them. The Government confirmed during negotiations that any tolls would only be levied on any section of the highways to be constructed or paved under the project after carrying out an economic evaluation satisfactory to the Bank and with the agreement of the Bank.

C. Highway Paving

5.12 The nine road sections to be paved under the project are located in five different provinces. Five roads are in the eastern central part of the country and two along the east coast, all oriented north-south. The two remaining roads are located in the south-western region and run east-west. All nine roads are national highways but serve largely regional interests as they link towns and villages to major arteries. Their improvement will assist the development of regions which are densely populated but presently rather isolated. The areas served depend essentially on agriculture, particularly on rice, barley, cabbage and other vegetables in most areas. In the Andong area, there is also fruit and tobacco, while on the east coast there is fishing, forestry and tourism. Coal mining and cement plants are located in the mountain ranges in the center and east near Yeongpung, Maepo and Samcheog. The present gravel roads were selected among a priority list established from traffic counts by the MOC. They are typical of roads included in a paving program, with traffic volumes ranging between 140 and 640 aadt, and require little or no realignment, within the service-life of the roads, to satisfy their multi-purpose transport function. Also the width and type of pavement are related to the traffic levels, including the use of Double Bituminous Surface Treatment (DBST) on the four roads which have the least traffic. Annex 2 gives additional details on the economic activities in the areas served by the roads.

5.13 The assessed benefits result about 60% to 70% from savings in vehicle operating costs due to the improved conditions on the newly paved highways compared with the existing rough gravelled roads, about 15% from reduction in road maintenance costs, and about 10% each from reduction in

travel time and generation of new traffic. The average vehicle operating costs, are shown in Table 16 and take into account highway standards, terrain condition and vehicle speed. The transport costs per km will be reduced by 27% to 45% for light vehicles and for taxies, by 25% to 36% for buses and by 22% to 36% for trucks. As the roads will follow closely their existing alignments, negligible benefit is obtained from distance reduction, but savings occur from reduced travel time due to increased speed of vehicles. Hourly time values per vehicle are identical with those used in the analysis of the highways for construction (para 5.10). In addition to reduced travel costs benefiting the road users, part of which may be passed on to urban consumers and to farmers in the areas served, benefits were quantified for the reduction of accidents due to better roads surface and the provision of overpasses at railroad crossings. The new pavements would bring also other non-quantified benefits such as quicker and improved services, reduction of the nuisance caused by heavy dust resulting from increasing traffic on the existing gravel surfaces.

5.14 The estimated streams of costs and benefits over the assumed 20 years service-life of the investments and economic returns (ERs) for each road are shown in detail in Table 19. ERs range between 15% and 37% with passenger time savings included, and between 12% and 33% without. The sensitivity of the ERs was tested under the same assumption as for the highway construction (para 5.11) and the pessimistic assumption gives ERs ranging between 10% and 28% (Table 20). These returns are satisfactory to justify the paving element of the project.

VI. RECOMMENDATIONS

6.01 During loan negotiations, the Government gave assurances on a number of matters, the more important ones being that it will:

(a) (i) cause the National Highway Network to be adequately maintained, and will make adequate arrangements satisfactory to the Bank for the timely provision of funds and resources required for that purpose and (ii) establish the MOC field organization for maintaining the National Highway Network in accordance with the revised schedule (para 3.25);

(b) (i) only levy tolls on any section of the highways to be constructed or paved as part of the project after carrying out an economic evaluation satisfactory to the Bank and with the agreement of the Bank (para 5.11), and (ii) prepare and submit to the Bank for review a policy statement relating to the Government's toll road system including the functions, responsibilities and budget of the KHC (para 3.12).

6.02 The project is suitable for a Bank loan of US$90 million (representing about 41% of total cost) for a period of 24 years, including a 4-year period of grace.

KOREA

THIRD HIGHWAY PROJECT

Description of Project Highways to be Constructed (including paving)

1. The four roads in this part of the project will be constructed, chiefly on new alignments, with two-lane pavements to design standards for construction (Table 10, Part A).

A. Seoul (Seongnam) - Icheon (43 km)

2. The northern starting point of the project road is at Seongnam (population 200,000), a rapidly expanding new city 13 km south of a new six lane bridge over the Han River in Seoul (population over 6 million). The existing road between Seoul and Seongnam is paved, partly six-lane and partly four-lane. Between Seongnam and Gwangju (population 15,000) 14 km, there is only a low grade unpaved mountainous track, which is winding and with gradients of 10%, and on some short segments up to 13%; the track is impassable during wet periods. From Gwangju to Icheon, (population 23,000) 29 km, the existing road is two-lane gravel surfaced and is poorly aligned for most of its length, narrow (much of it only 8 m including shoulders) and gradients reach 10% in some places. The gravel surface is quite inadequate for even the present traffic, and is very rough. Also, there are several narrow and very congested sections through villages. At Icheon, there is an interchange with the recently constructed Suwon (Singal)-Weonju-Gangreung Highway.

3. The new highway will be constructed on a better alignment, with 7.20 m wide asphalt concrete two-lane pavement and 3 m wide shoulders. Between Seongnam and Gwangju, the design speed is 120 km/h on the flatter sections at each end; in the center section the road crosses a mountain divide, where the design speed is reduced 70 km/h, and there will be a 300 m long tunnel to permit a better alignment (including reduction in gradients to a maximum of 7%) and to reduce rock excavation. Between Gwangju and Icheon, the design speed is mainly 100 km/h except for two hilly areas north of Icheon, where it is 70 km/h, and the maximum gradient is 6%. The new road is designed for ultimate divided four-lane width, and for the provision of eventual grade separated interchanges at Seongnam and Gwangju. The construction includes eleven bridges between 15 m and 205 m in length. From Icheon, southwards to Judeog, the existing unpaved road is to be paved under the project (Annex 2, Section A).

4. Present traffic volume is about 920 annual average daily traffic (aadt) at the outskirts of Seoul and decreases to about 460 aadt near Icheon, except for a 14 km section between Seongnam and Gwangju where traffic is only 80 aadt. The bad condition of that section of road crossing a mountainous range deters traffic from using it, although it is shorter by about 20 km than the alternative northern route which is used by most vehicles. The traffic composition ranges from about 8% to 15% for light vehicles, 11% to 49% for buses and 43% to 80% for trucks. At the opening of the new road in 1978, the weighted average traffic is expected to exceed 2,000 aadt. This would include a considerable amount of diverted traffic, of about 1,200 aadt. Most of the traffic diverted would be from the longer alternatives via the northern route and via the Seoul-Singal-Icheon (toll) expressway but also a small amount from rail (about 125 aadt); generated traffic would be about 100 aadt. The growth rates assumed from normal and generated traffic are given in Table 16. The road is located within the influence of metropolitan Seoul and directly serves expanding industrial and residential areas as well as through traffic to the southeast of Seoul. Services and light industries, and the production of vegetables for the Seoul market, are developing rapidly.

B. Daegu - Masan (85 km)

5. The present road is 95 km long and is unpaved except for 24 km at the northern end in and near the city of Daegu (population 1,200,000) and very short sections through the towns of Hyeonpung (population 13,000) Changnyeong (population 25,000), Yeongsan (population 15,000) and Nangi (population 21,000). At the southern end the road joins the Masan-Jinju Highway, about 3 km west of Masan (population 320,000). The gravel surfacing is extremely rough, narrow (varying from a 7 to 10 m including shoulders) and the alignment is generally poor, with average travel speeds of 30 to 35 km/h. The paved sections are mainly in villages or built up areas, where travel speed is limited by congestion.

6. The new road (85 km) will be constructed on a new alignment with 7.20 m wide asphalt concrete two-lane pavement, and 3 m wide shoulders. The design provides for ultimate widening to divided four-lane width. At the northern end, the new alignment is located around the north west perimeter of the city of Daegu, and will form part of its planned ring road. Provision has been made for future interchanges. The new alignment then crosses a mountainous area southwest of Daegu, including a 620 m long tunnel. At the southern end, the road will join the new Jinju-Masan-Busan Highway where an interchange will be constructed. A total of 30 bridges will be built including a 680 m long bridge over the Nagdong River near Namji; the remaining bridges vary in length from 12 m to 420 m.

7. The present traffic varies between 1,850 and 1,500 aadt for the first 13 km south of Daegu and drops to about 500 aadt for the balance of the road to the Masan interchange. The traffic composition is about 50%

truck, 35% buses and 15% light vehicles. The weighted average traffic expected at the opening of the road in 1978 is about 1,850 aadt and comprises substantial diversion from the alternative route via the Seoul-Busan toll expressway (750 aadt) and some from rail (70 aadt); generated traffic would amount to about 200 aadt. The road will serve as a beltway for the west part of Daegu where most of the industrial and residential expansion has been planned. It will also link Daegu with the Masan-Jinhae area which is also developing rapidly with its Free Zone Industrial Complex, the Changwon industrial complex, and other activities. The area is densely populated and agriculture is diversified including rice, cabbage and fruits; fish is also produced, in ponds.

C. Pohang - Yeongdeog (45 km)

8. The present road from Pohang to Yeongdeog is 48 km long and gravel surfaced, except for a paved section for the last 7 km between Ganggu and Yeongdeog. The remainder of the road has a rough gravel surface width from 7 m to 9 m including shoulders. The paved section through the largely built up area of Ganggu-Yeongdeog has a narrow and irregular pavement and shoulders (generally 6 m wide pavement and 1 m shoulders). The road runs parallel with the coast and crosses a number of rivers, and some hilly sections. The alignment is poor in many sections; the maximum gradient is about 8% and average travel speed is 30 to 35 km/h.

9. The new road will be constructed on an improved alignment, starting at the end of the existing pavement at the northern side of Pohang. However, the existing alignment is being retained on a few sections where the road crosses flat terrain and the alignment is already generally good. The pavement will be 7.20 m wide, with 1.75 m wide shoulders. The design speed is generally 100 km/h, except for hilly areas, where it is reduced to 70 km/h. The maximum gradient is 7% and occurs at only one place. A total of 13 new bridges will be constructed, ranging from 24 m to 270 m long. One existing bridge 70 m long is in good condition and will be retained. From Yeongdeog, northwards to Uljin and Samcheog, the existing unpaved road is to be paved under the project (Annex 2, Sections E and F).

10. The present traffic varies from 450 to 600 aadt and comprises 50% trucks, 35% buses and 15% light vehicles. Traffic volumes in 1978 are forecast to range between about 560 and 1,030 aadt, as the result of normal and generated growth; no traffic diversion is expected. Except for Pohang and its steel mill and related activities, there are no industries in the area but improved communications may help to attract new industries. Agriculture on the narrow land strip between the mountains and the sea is generally for subsistence. Fishing is the major activity of Ganggu and Yeongdeog and the other villages along the coast and should benefit from better transport; also tourism could develop in the very scenic coastal area.

D. Suncheon - Beolgyo (22 km)

11. The present road is 25 km long, and is unpaved. The alignment is poor and there are seven railway level crossings (at grade). The road is narrow (6 m to 8 m wide including shoulders). The maximum gradients are 7% to 8% in the mountainous area near Beolgyo. Because of the poor alignment, rough road surface, and the railway level crossings, the average travel speed is 25 to 30 km/h. West of Beolgyo, the unpaved road to Mogpo is to be paved under the project (Annex 2, Sections G and H).

12. The new road (22 km) will be constructed on a new alignment and will have a design speed of 100 km/h, except for the last one km connecting with the existing paved streets in Suncheon. Maximum gradients will be 6% and will be short. The road will have a 7.20 m wide asphalt concrete two-lane pavement, with 1.75 m wide shoulders. Nine bridges are to be constructed between 12 m and 150 m long. Three of the bridges will be over the railway to eliminate level crossings; the remaining four railway level crossings will be eliminated by the realignment of the road.

13. The present traffic decreases from 420 to 340 aadt between Suncheon (population 110,000) and Beolgyo (population 47,000) and its composition is about 60% trucks, 25% buses and 15% vehicles. The traffic volume is expected to reach an average of about 600 aadt at the opening of the road in 1978. The area served by the new road is moderately populated and produces vegetables, mainly tomatoes in numerous greenhouses, fruit and rice; also fish in the coastal villages.

January 1976

KOREA

THIRD HIGHWAY PROJECT

Description of Project Highways to be Paved

1. The nine roads in this part of the project will be paved, mainly on their present alignments, but with improvement of curves and widening of the roadway and shoulders, to design standards for paving (Table 10, Part B).

A. Icheon-Judeog (53 km)

2. The Icheon-Judeog road is a continuation of the Seoul-Icheon road which is to be constructed under the project (Annex 1). The present road is generally on a fairly good alignment, but is unpaved, with a rough gravel surface, and is narrow (generally about 8.5 m total width including shoulders). The terrain is half flat to rolling and half rolling to hilly. The maximum gradients are 4% to 6% and average travel speeds are around 40 km/h. The remaining 12 km between Judeog and Chungju (population 90,000) is already paved and is not included in the project.

3. The road will be reconstructed, chiefly on the existing alignment, and paved with asphalt concrete. The standards will be Paving Type C for the 21 km between Icheon (population 23,000) and Janghoweon (population 20,000) with a 7 m wide pavement and 2 m wide gravel shoulders. From Janghoweon to Judeog, the standards will be Type B, with a 6.70 m pavement and 1.50 m gravel shoulders. There are 26 bridges on the existing alignment. Nine of these will be replaced with box culverts, and three with new bridges with lengths of 24 m to 40 m. Eight of the remaining 14 bridges will be repaired.

4. The present traffic decreases from about 640 to 360 aadt between Icheon and Judeog and is composed of about 60% trucks, 30% buses and 10% light vehicles. The expected traffic in 1978 when the road is improved, will vary from about 1,000 to 570 aadt with generated and diverted traffic from rail and road amounting to about 100 aadt each. The area is densely populated and prosperous; its main production is rice alternating with barley or wheat together with cabbages and other vegetables.

B. Chungju-Gimcheon (103 km)

5. The total length of the existing road between Chungju (population 90,000) and Gimcheon (68,000) is 132 km. However, there are some sections which are already paved totalling 29 km, mainly a 15 km section north of Jeomchon (population 41,000) and a 13 km section north of Gimcheon. The remaining 103 km is presently unpaved, with a rough gravel surface and narrow; the width is generally 6 m to 8 m wide including shoulders between Chungju and Sangju, and about 7 m to 10 m wide between Sangju (population 58,000) and Gimcheon. Between Chungju and Jeomchon the terrain is predominantly hilly with some mountainous sections having gradients of 8% to 9%; average travel speeds are 30 to 35 km/h. From Jeomchon to Sangju, the first 20 km is mainly mountainous, with gradients or 8% to 9%, and average travel speeds about 25 km/h. The remainder is generally flat, with an average travel speed of about 45 km/h. Between Sangju and Gimcheon, the terrain is flat to rolling except for one short hilly to mountainous section where the maximum gradient is 8%; average travel speed is 45 km/h on the present gravel road.

6. The total unpaved length of 103 km will be reconstructed, mainly on the existing alignment, and paved with asphalt concrete. However, a length of about 9 km in Sangju will be realigned, in accordance with the town plan, to avoid the congested town center. The standards will be Type B with a 6.70 m wide pavement and 1.5 m wide gravel shoulders. Between Chungju and Jeomchon, four of the existing 12 bridges will be replaced with box culverts, and three with new bridges between 30 m and 41 m long; one of the remaining four bridges will be repaired. Between Jeomchon and Sangju, nine of the 24 bridges will be replaced with box culverts and seven new ones built with lengths between 30 m and 154 m; four of the remaining bridges will be repaired. In addition, two railway overpasses will be constructed to eliminate at-grade crossings. Between Sangju and Gimcheon, eight of the 19 bridges will be replaced with box culverts and three with new bridges; six of the remainder will be repaired. In addition, five new railway overpasses will be constructed to eliminate level crossings.

7. Present traffic volume is about 600 aadt for the whole road, except for the mountainous section between Chungju and Salmi where traffic decreases to about 350 aadt. The traffic composition is about 50% to 60% trucks, 25% to 35% buses and 15% light vehicles. At its opening in 1978, the road is expected to carry about 900 aadt except for its middle part which should have 600 aadt; diverted and generated traffic is expected to average about 150 aadt. Agriculture is well developed with large villages, particularly in the south part between Jeomchon and Gimcheon where the terrain is flat. Crops include rice, barley and fruit. In the mountainous section, coal mining near Jeomcheon is the sole economic activity.

C. Maepo - Andong (87 km)

8. The road from Weonju (population 115,000) to Maepo (population 7,000) was paved under the Second Highway Project. The road from Maepo through Danyang (population 10,000), Punggi (25,000) and Yeongju (65,000) to Andong (80,000) is presently unpaved, except for 8 km in Yeongju, and short sections in the other towns. The terrain is about 50% mountainous, 20% rolling to hilly, and the remainder flat. The alignment, governed by the terrain, is fair to poor, with maximum gradients in the mountainous areas 8% to 10% (exceptionally up to 12%); travel speeds average about 25 km/h between Maepo and Punggi and about 35 km/h between Punggi and Andong. The gravel surface is rough and the total width of the road, including shoulders is generally 5 m to 7 m between Maepo and Punggi and 6 m to 8 m between Punggi and Andong.

9. The total length to be improved and paved is 87 km. The alignment predominantly follows the existing road, but includes minor improvements to reduce curvature, which can be carried out at relatively low cost. The design standards will be Type C on the 9 km section Punggi-Yeongju, which carries heavier traffic; the pavement will be asphalt concrete 7 m wide with gravel shoulders 2 m wide. For lengths of 18 km south from Maepo, and 4 km north from Punggi, as well as the 40 km section Yeongju-Andong, will be constructed to Type B, with 6.70 m wide pavement and 1.5 m gravel shoulders. The remaining 17 km long mountainous section between Maepo and Punggi will be improved to Type A, with a 6 m wide pavement and 1 m wide gravel shoulders. Of the 17 bridges between Maepo and Punggi, six will be replaced with box culverts and one with a new bridge; the remaining ten will be retained, but with minor repairs. Between Punggi and Andong, six of the present 17 bridges will be replaced with box culverts, one widened, and three replaced with new bridges between 20 m and 30 m long. Three of the remaining seven bridges will be repaired. A 40 m long railway overpass will be constructed south of Weonju to eliminate an "at-grade" crossing.

10. The present traffic increases from about 260 aadt near Maepo to 440 aadt near Andong and its composition is about 70% trucks, 20% buses and 10% light vehicles. In 1978 traffic is expected to increase to the range of 430 to 680 aadt respectively, due to normal and generated growth, some small diversion from other roads is also expected. The area is mountainous and has little population in the first 40 km of the road to Punggi, except for a few towns such as Maepo and Danyang where cement plants are located. Between Punggi and Andong is thickly populated and agriculture is prosperous; major crops are rice, Ginseng, and fruit, mainly apples and pears. Some tourist attractions such as the Buseog temple near Yeongju, should become more popular with the improvement of the road.

D. Weongju-Hayeong (40 km)

11. The present road between Weonju (population 115,000) and the small town of Hayeong is unpaved; the remaining 14 km between Hayeong and Chungju (population 90,000) is already paved and is not included in the project. The terrain between Weonju and Hayeong is mainly flat to rolling, but the road crosses two mountainous areas. The alignment is fair, but deteriorates in the mountainous areas, where maximum gradients are 7% to 10%. The present gravel surfaced road is rough and only 5.5 m to 7 m wide, including shoulders. Average travel speed is about 30 km/h.

12. The road will be reconstructed to design standards Type B, with a 6.70 m wide asphalt concrete pavement section and 1.50 m wide gravel shoulders, for 12 km south of Weonju, and to Type A, with 6 m wide asphalt concrete pavement and 1 m wide gravel shoulders for the remaining 28 km to Hayeong, including the two mountainous areas. Of the existing 22 bridges, 11 will be replaced with box culverts and 7 with new bridges with lengths between 30 m and 80 m. The remaining 4 bridges will be retained.

13. Present traffic between Weonju and Hayeong decreases gradually from about 500 aadt near Weonju to about 200 aadt near Hayeong; its composition is about 55% trucks, 35% buses and 10% light vehicles. With the road improved by 1978, traffic should increase to about 820 to 380 aadt, and include in addition to generated traffic some diversion from other roads and rail. The area is moderately populated and has subsistence farming.

E. Yeongdeog-Uljin (76 km)

14. The Yeongdeog-Uljin road is a continuation of the Pohang-Yeongdeog road which is to be constructed under the project (Annex 1, Section C). The present road is unpaved. From Yeongdeog (population 11,000) it passes through terrain which is initially flat, but it becomes hilly (30%), rolling (20%), and then hilly to mountainous (50%), towards Uljin (8,000). The alignment is good in the flat areas, but deteriorates in the mountainous areas, with maximum gradients of 9% to 10%. Average travel speed on the rough gravel surfaced road varies from 40-50 km/h in the better sections to about 25 km/h in the mountainous areas. The overall roadway width varies from 5 m to 8 m including shoulders.

15. The entire length will be reconstructed to Type A standards, with 6 m wide asphalt concrete pavement and 1 m wide gravel shoulders. The road will be reconstructed predominantly on the existing alignment, but with minor improvements to correct curvature. There are presently 39 bridges with lengths from 5 m to 228 m. 15 of the bridges will be replaced with box culverts, two will be eliminated by realignment of the road, and five will be replaced with new bridges; the remaining 17 bridges will be retained, of which 14 will be repaired.

16. Present traffic is about 450 aadt for the whole road section and its composition is about 45% buses, 50% trucks and 5% light vehicles. By 1978, traffic should increase to about 700 aadt through normal and generated growth. The population is concentrated in numerous small farming and fishing villages along the coast. The main cash production is dried fish.

F. Uljin-Samcheog (71 km)

17. The present road is unpaved. For the first 27 km between Uljin (population 8,000) and Hosan (2,000) the terrain is mainly rolling, but with one short mountainous area where maximum gradients are 9% to 10%. Average travel speed is about 30 km/h. Between Hosan and Samcheog (41,000) the terrain is mainly mountainous, since the road traverses three mountainous divides, but with relatively short flatter sections between the mountainous sections where the road runs along stream valleys or on the coastline. The alignment is generally poor, with sharp curvature in the mountainous areas and maximum gradients of about 10%. Average travel speed is 20 to 25 km/h. The present roadway is narrow, generally only 5 m to 7 m wide including shoulders, but a few short sections have been widened to 10 m.

18. The entire road will be reconstructed to Type A standards with 6 m wide pavement and 1 m wide gravel shoulders. The pavement will be double bituminous surface treatment (DBST) to reduce the cost, in view of the lower traffic on this road section. South of Samcheog there is a section of 3 km where the road alignment will make use of the embankment and three tunnels of a railway which was under construction about 30 years ago, but was abandoned. Traffic will be "one way" controlled by light signals. However, the capacity will be adequate for present traffic, and the railway alignment shortens the route by 3 km and avoids the expensive construction of 6 km through a steep mountainous area.

19. The present traffic is about 320 aadt for the first 8 km section of the road from Uljin toward Hosan, decreases to about 150 aadt for the central 55 km section and increases to about 430 aadt for the last 8 km near Samcheog. The traffic forecast for these sections in 1978 is respectively about 480, 240 and 650 aadt, including normal and generated traffic. The traffic composition is about 45% each for trucks and buses and 10% light vehicles. This coastal area is moderately populated with numerous small villages. The major activities are fishing and farming. Cement plants are located in Samcheog and some timber is extracted in parts of the forested foot-hills of the north-south mountainous range.

G. Beolgyo-Gangjin (67 km)

20. The Beolgyo-Gangjin road is a continuation of the Suncheon-Beolgyo road which is to be constructed under the project (Annex 1, Section D).

For slightly over half its length, the road from Beolgyo (population 46,000) via Boseong (22,000) to Gangjin (28,000) is flat to rolling. There are hilly to mountainous areas for 3 km west of Beolgyo, 4 km east from Boseong and 14 km west of Boseong. Alignment is fairly good except in the mountainous areas. Maximum gradients are about 8% and average travel speeds are about 35 km/h. The existing gravel road varies in width from about 6 m to 10 m including shoulders.

21. The road will be reconstructed and paved to Type A standards. The pavement will be DBST, since traffic is relatively light, 6 m wide with 1 m gravel shoulders. However, at Gangjin there is an existing gravel surfaced bypass road 3 km long, close to the town, which was completed in 1972. The work will include the paving of the bypass to Type B Standards, with 6.70 m wide pavement and 1.50 m gravel shoulders. Of the 36 existing bridges, 18 will be replaced with box culverts and nine replaced with new bridges, having lengths from 12 m to 54 m. Nine existing bridges will be retained, of which four will be repaired.

22. The present traffic is about 250 aadt and its composition about 50% trucks, 40% buses and 10% light vehicles. Traffic forecast for 1978 is about 350 aadt, including normal and generated growth. The area is predominantly producing rice in flat irrigated land mainly near Boseong. Production of tomatoes and other vegetables in greenhouses is developing rapidly in this area.

H. Seongjeon-Mogpo (40 km)

23. The present road is 33 km long from Seongjeon (population 13,000) to Mogpo (200,000) and traverses generally flat to rolling terrain but with some hilly sections with maximum gradients up to 8%. Average travel speed is 35 to 40 km/h. The roadway is largely only about 6 m wide including shoulders, but some sections have been widened to 10 m overall. The project includes also a 7 km section of road south from Seongjeon towards Haenam to Gaegog which carries substantial traffic. The existing road is gravel surfaced and has been widened to 9 m to 10 m including shoulders. The terrain is rolling with maximum gradients of 5% and travel speed averages about 40 to 45 km/h.

24. The road from Seongjeon to Mogpo will be improved, mainly on the existing alignment, to Type A standards with a 6 m wide DBST pavement and 1 m wide gravel shoulders. The 7 km section of road from Seongjeon south to Gaegog will be paved to Type B with 6.70 m wide DBST pavement and 1.50 m wide gravel shoulders. Of the eight existing bridges, four will be replaced with box culverts and the remainder will be repaired.

25. The present traffic between Seongjeon and the Mogpo ferry south terminal is about 180 aadt but the branch Seongjeon-Gaegog carried about 540 aadt. Traffic forecast for 1978 is respectively 260 and 780 aadt.

The present composition of traffic is about 55% trucks, 30% buses and 15% light vehicles. The area is principally devoted to agriculture with rice and fish ponds but is somewhat isolated from the influence of Mogpo due to the state of the present road and the time taken for the 2 km wide ferry crossing.

I. Sangju-Gasan (64 km)

26. The present road from Sangju (population 58,000) to Gasan (10,000) is unpaved, but the alignment is generally fairly good. The terrain is mainly flat to rolling, with a few short hilly sections. Average travel speeds are 50 km/h in the flat to rolling areas and 40 km/h in the hilly areas. Some widening has been carried out and the width averages 8 m to 9 m including shoulders.

27. The road will be reconstructed and paved, almost entirely on the existing alignment, except where the bridges are being replaced and approaches improved. The standards will be Type A with 6 m wide DBST pavement and 1 m wide gravel shoulders. Four of the present 44 bridges on the road will be replaced with box culverts and four by new bridges. The remaining 36 bridges will be retained, of which nine will be repaired.

28. The present traffic is about 200 aadt and its composition about 55% trucks, 35% buses and 10% light vehicles. In 1978, when the road will have been improved, traffic is expected to increase to about 350 aadt including some diverted traffic from other roads and rail, and some generated traffic. The area served by the road is flat irrigated land, producing rice along the Nagdong river. The area is thickly populated and has potential for further development.

January 1976

KOREA

THIRD HIGHWAY PROJECT

Domestic Freight and Passenger Traffic Data, 1967 and 1971/5

Freight 1/	1967 Ton-Km (million)	1967 (%)	1971 Ton-Km (million)	1971 (%)	1967-71 Average Annual Increase (%)	1972 Ton-Km (million)	1972 (%)	1972 Increase (%)	1973 Ton-Km (million)	1973 (%)	1973 Increase (%)	1974 Ton-Km (million)	1974 (%)	1974 Increase (%)	1975 (Forecast) Ton-Km (million)	1975 (Forecast) (%)	1975 (Forecast) Increase (%)	1971-75 Ave. Annual Increase %
Highway	660	8.4	3,302	20.9	49.4	2,494	18.3	-24.5	3,149	19.8	26.3	3,908	22.8	24.1	4,373	22.6	11.9	7.3
Railroad	6,178	78.4	7,841	49.6	6.1	7,241	53.1	-7.7	8,591	53.9	18.6	8,921	52.1	3.8	10,156	52.5	13.8	6.7
Coastal Shipping	1,043	13.2	4,653	29.5	45.2	3,905	28.6	-16.1	4,200	26.3	7.6	4,291	25.1	2.2	4,819	24.9	12.2	0.9
Total	7,881	100.0	15,796	100.0	19.0	13,640	100.0	-13.6	15,940	100.0	16.9	17,120	100.0	7.4	19,348	100.0	13.0	5.2
Passenger 2/	**Pass-Km (million)**	**(%)**	**Pass-Km (million)**	**(%)**		**Pass-Km (million)**	**(%)**	**Increase (%)**	**Pass-Km (million)**	**(%)**	**Increase (%)**	**Pass-Km (million)**	**(%)**	**Increase (%)**	**Pass-Km (million)**	**(%)**	**Increase (%)**	
Highway	11,699	54.3	22,917	71.1	18.3	26,258	71.1	14.6	32,126	73.6	22.3	35,232	75.0	9.7	40,054	73.8	13.7	15.0
Railroad	9,577	44.4	8,750	27.1	-2.1	10,062	27.2	15.0	10,720	24.5	6.5	10,970	23.6	2.3	13,213	24.3	20.4	10.9
Coastal Shipping	223	1.0	256	0.8	3.4	301	0.8	17.6	425	1.0	41.2	242	0.5	43.1	257	0.5	6.2	0.0
Aviation	62	0.3	314	1.0	50.2	323	0.9	2.9	385	0.9	19.2	300	0.6	22.1	333	0.6	11.0	1.5
Subway	—	—	—	—	—	-	-	—	-	-	—	143	0.3	-	432	0.8	202.1	18.9
Total	21,561	100.0	32,237	100.0	10.6	36,944	100.0	14.6	43,656	100.0	18.2	46,887	100.0	7.4	54,289	100.0	15.5	13.9

1/ Figures include only commercial freight and do not account for private transport. The data thus underestimate road transport and its importance might be nearly equal to that of railroad in 1975.

2/ Figures include only public transport and do not account for movement of passengers on private vehicles; the data thus also underestimate road transport but to a lesser extent than for freight since there are only few passenger vehicles for private use in the fleet (less than 15% in 1974 or about 2000 buses and 20,000 light vehicles in a total fleet of about 180,000 units)

SOURCE: Statistics Yearbook of Transportation, 1974, Ministry of Transportation.

Table 1

January 1976

Table 2

KOREA

THIRD HIGHWAY PROJECT

Public Transport Investment During Second (1967/71) and Third (1972/76) Five-Year Economic Development Plans
(billion Won)

Transport Mode	Central and Local Governments		
	Second Plan[1]	Third Plan[2]	'72 to '73[3]
Highways	123.4	227.1	102.9
Railroad	85.8	105.6	89.9
Ports and Maritime Transport	30.2	60.3	35.1
Airports	4.2	11.3	5.9
Storage	1.3	15.1	9.4
Seoul Subway	-	72.3	(31.5)[4]
Sub-total	244.7	491.6	243.2 (31.5)
Total Government Capital Expenditure	904.3	1,864.8	967.4
Transport as Proportion of Total	27%	26%	25%

1/ Actually spent, at current prices
2/ Planned at 1970 prices
3/ At current prices, Central Government Investment only.
4/ Seoul City Investment

Source: Ministry of Construction

January 1976

Table 3

KOREA

THIRD HIGHWAY PROJECT

Public Roads Network, 1974
(Km)

Category and Type	Total Length	Paved	(%)	Graveled	(%)	Unsurfaced	(%)
National Highways							
Expressways (tolls)1/	643	643	100	-		-	-
New national highways	370	370	100				
Other national highways (primary and secondary)	8,288	3,071	37	5,206	63	11	-
Sub-total	9,301	4,084	44	5,206	56	11	-
Local Roads							
Provincial highways	10,875	634	6	9,896	91	345	3
Special city roads	6,610	2,912	44	3,667	55	31	1
City and county roads	17,392	1,020	6	13,353	77	3,019	17
Sub-total	34,877	4,566	13	26,916	77	3,395	10
Total	44,178	8,650	19	32,122	73	3,406	8

Road Density in 1974:

Km/Km^2	0.5
Km/1000 inhabitants	1.3

1/ 140 km are 2 lane non-divided expressways

SOURCE: Ministry of Construction

January 1976

Table 4

KOREA

THIRD HIGHWAY PROJECT

Registered Motor Vehicles, 1962-74

Year	Cars 1/	Trucks	Buses 2/	Others 3/	Total
1962	8,733	13,093	6,747	2,241	30,814
1963	9,569	13,929	8,132	2,598	34,228
1964	11,409	14,951	8,617	2,836	37,813
1965	13,001	16,015	9,316	3,179	41,511
1966	17,502	19,432	10,888	2,338	50,160
1967	23,235	22,955	11,499	3,008	60,697
1968	33,112	31,582	12,786	3,471	80,951
1969	50,299	40,134	14,237	3,999	108,669
1970	60,677	48,901	15,831	3,962	129,371
1971	67,582	53,405	17,411	5,939	144,337
1972	70,250	55,292	17,550	6,943	150,035
1973	78,334	64,584	18,871	9,025	170,714
1974	76,462	76,833	20,060	10,189	183,544
		% Average Annual Growth			
1962-71	25.5	16.9	11.1	11.4	18.1
1967-71	30.5	23.5	10.9	18.8	24.2
1970-71	11.4	9.2	10.0	49.9	11.6
1971-72	3.9	3.5	0.8	16.9	4.0
1972-73	11.5	16.8	7.5	30.0	13.8
1973-74	2.4	19.0	6.3	12.9	7.5
		% Changing Composition			
1962	28.3	42.5	21.8	7.4	100
1967	38.4	37.8	18.9	4.9	100
1971	46.8	37.0	12.1	4.1	100
1972	46.8	36.9	11.7	4.6	100
1973	45.9	37.8	11.0	5.3	100
1974	41.7	41.9	10.9	5.5	100

1 Vehicle per 185 population (1974), compared to 1 per 50 in Thailand and 1 per 70 in the Philippines.

1/ Includes taxis
2/ Includes microbuses
3/ Public service, motorcycles, and special vehicles

Source: Ministry of Transportation and Mission Estimates, April 1975

January 1976

KOREA

THIRD HIGHWAY PROJECT

Korean Motor Vehicle Production, 1962-75

Year	Cars	Buses	Trucks (1)	Total
1962	991	42	884	1,917
1963	1,430	233	143	1,806
1964	179	405	108	692
1965	166	1,251	965	2,382
1966	3,398	1,482	559	5,439
1967	5,033	941	1,512	7,486
1968	11,421	1,632	5,212	18,265
1969	10,727	1,884	9,626	31,237
1970	13,636	3,690	13,032	30,358
1971	12,428	3,063	7,511	23,002
1972	9,525	2,581	6,542	18,648
1973	12,751	3,494	10,069	26,313
1974	9,069	3,945	17,276	30,290
1975 2/	25,184	4,100	19,300	48,584
	% Average Annual Growth			
1962-71	32.4	61.1	26.8	28.8
1971-72	-33.4	15.7	12.9	18.9
1972-73	33.9	35.4	53.9	41.2
1973-74	-28.9	12.9	71.6	15.1
1974-75	177.7	3.9	11.7	60.4
1971-75	19.3	7.6	26.6	20.6

1/ Includes three-wheel vehicles
2/ Estimates

SOURCE: Ministry of Commerce and Industry

January 1976

Table 6

KOREA

THIRD HIGHWAY PROJECT

Motor Vehicle Fuel Consumption, 1962-75[1/]
(1000 kiloliters)

Year	Gasoline	Diesel
1962	180	225
1963	97	358
1964	102	386
1965	223	507
1966	336	558
1967	481	765
1968	573	1,251
1969	748	1,507
1970	865	1,775
1971	992	2,099
1972	976	2,338
1973	1,040	2,838
1974	698	2,918
1975[2/]	691	3,045
	% Average Annual Growth	
1962-71	27.9	28.2
1967-71	19.8	28.7
1971-75	-8.6	9.7

1/ Gasoline consumption is totally for vehicles, but diesel consumption includes 20-30% of other consumption.
2/ Estimates

SOURCE: Ministry of Commerce and Industry

January 1976

Table 7

KOREA

THIRD HIGHWAY PROJECT

Highway Authorities and Agencies

	Expressways (Tolls)	National Highways		Provincial Highways 1/	City/County Roads
Planning	MOC	MOC		9 Provincial Construction Bureaus (PCB)	City/County Construction Sections (CCS), assisted by PCB
Construction Design and Supervision	Korea Highway Corporation (KHC)	MOC, through its 9 Territorial Construction & Management Offices (TCMO's) assisted by consultants as necessary		PCB	CCS
Financing	MOC/KHC 2/	MOC		Provinces with MOHA grants; also occasional grants for special projects	City/County with Provincial grants
Maintenance Execution authority/ agency		through 1975 3/	from 1976 4/		
Paved	KHC	PCB	MOC	PCB	PCB
Unpaved	-	CCS		CCS	CCS
Financing	KHC	MOC and provinces	MOC	Provinces with MOHA grants	City/County with Provincial grants

1/ The Special Cities of Seoul and Busan (City Construction Bureaus) have functions similar to Provincial Governments.

2/ KHC was created in January 1969, but has not so far financed any construction

3/ MOC became responsible for maintenance in one ("pilot") province in September 1972; it is scheduled to take over maintenance in remaining 8 provinces by Oct. 1, 1976.

4/ As soon as MOC highway maintenance organization becomes effective, or at latest from Oct. 1, 1976, 9 TCMOs (Territorial Construction and Management Offices) will carry out maintenance, through their 19 NHMOs (National Highway Maintenance Offices), of all national highways.

SOURCE: Ministry of Construction

January 1976

KOREA

THIRD HIGHWAY PROJECT

Expenditures on Roads, 1962/66 and 1967/74[1/]
(million Won)

	Total First Plan 1962/66	1967	1968	1969	1970	1971	Total Second Plan 1967/71	1972	1973	1974
Government Expenditures on National Highways										
Administration	74	12	64	244	307	319	946	680	700	660
Construction	3,811	1,853	13,316	29,192	25,049	19,612	89,022	32,746	33,244	31,717
Maintenance[2/]	193	165	240	282	300	461	1,448	716	842	1,612
Sub-total	4,078	2,030	13,620	29,718	25,656	20,392	91,416	34,142	34,786	33,989
Expenditures on Provincial and County Roads[3/4/]										
Construction	2,174	1,434	2,843	6,063	7,026	8,920	28,286			
Maintenance[5/]	851	729	1,004	864	1,226	1,914	5,737			
Sub-total	3,025	2,163	3,847	6,927	8,252	10,834	32,023			
Total	7,103	4,193	17,467	36,645	33,908	31,226	123,439			

1/ At current prices.
2/ Does not include funds contributed by provinces for the maintenance of national highways.
3/ Seoul City excepted.
4/ Includes Government grants.
5/ Maintenance includes expenditure on national highways estimated up to 70% of the total but does not include the value of voluntary labor provided for all highways.

SOURCES: Ministry of Construction, Ministry of Home Affairs

January 1976

Table 8

KOREA

THIRD HIGHWAY PROJECT

Highway User Charges, 1967-75
(million Won)

Revenue	1967	1968	1969	1970	1971	1972	1973	1974	1975[1]
National taxes									
Fuel taxes[2]	4,048	9,680	12,791	16,959	29,083	27,717	36,582	83,717	115,852
Gasoline tax	(2,687)	(6,796)	(9,365)	(12,185)	(21,185)	(19,593)	(25,821)	(57,236)	(83,817)
Diesel tax	(1,361)	(2,884)	(3,426)	(4,774)	(7,898)	(8,124)	(10,761)	(26,481)	(32,035)
Transport. tax	4,025	5,581	8,387	12,238	14,641	16,000	18,801	13,484	18,720
Commodity tax	669	1,075	2,158	5,060	4,465	3,535	6,613	7,499	8,259
Sub-total	8,742	16,336	23,336	34,257	48,189	47,252	61,996	104,700	142,831
Local taxes									
Vehicle tax (incl. surcharge)	1,500	2,488	3,869	5,606	6,393	7,191	8,718	12,927	13,408
License fee and acquisition tax	250	584	881	1,165	1,799	1,661	NA	NA	NA
Sub-total	1,750	3,072	4,750	6,770	8,192	8,852	8,718	12,927	13,408
Tolls	-	6	459	1,987	3,498	4,995	6,276	6,887	8,383
Total	10,492	19,414	28,545	43,014	59,879	61,099	76,990	124,514	164,622

1/ Estimated
2/ Total revenues, not only proportion earmarked for highways

Table 9

SOURCES: Ministry of Construction, Ministry of Finance, Ministry of Home Affairs.

January 1976

KOREA

Table 10

THIRD HIGHWAY PROJECT

Design Standards for Two-Lane National Highways (Rural)

A. Construction (including paving, mainly on new alignment)

Geometric Design Standards	Unit	Terrain			
		Flat	Rolling	Hilly	Mountainous 1/
Design speed	km/h	120	100	70	50
Minimum radius of curvature	m	630	390	170	80
Maximum gradient	%	4	5	7.0	8

Roadway Features (all areas)	Unit	
Width of pavement	m	7.20
Width of shoulders	m	3.00-1.75
Width of right-of-way	m	30 minimum 2/

Structural Design Features (all areas)		
Axle-load (pavement)	lbs	18,000 3/
Bridge loading	-	DB-18, equivalent to AASHO H20-S16
Bridge widths (for new bridges) (over 60-100 m long) 4/	m	10.70
Vertical clearance (over roads)	m	4.80

B. Paving (mainly on existing alignment, with limited improvement)

Geometric Design Standards	Unit	Terrain		
		Flat to Rolling	Hilly	Mountainous 1/
Design speed	km/h	80	60	40
Minimum radius of curvature:				
Desirable	m	300	175	80
Minimum	m	230	120	50
Maximum gradient	%	6	7	9

Roadway Features (all areas)	Unit	Traffic Levels aadt (estimated 10 years after completion of paving)		
		Under 1,200 Type A	1,200-2200 Type B	Over 2,200 Type C
Width of payment	m	6.00	6.70	7.00
Width of shoulders	m	1.00-0.65	1.5-0.65	2.00-1.15
Width of right-of-way 5/	m	25	25	25

Structural Design Features (all areas)	Unit	
Axle-load (pavement)	lbs	18,000 3/
Bridge loading	-	DB-18, equivalent to AASHO H20-S16
Bridge widths (for new bridges) 6/		
Rural areas	m	8.50
Urban areas	m	10.00
Vertical clearance (over roads)	m	4.80

1/ Design speeds and widths may be reduced and gradients increased on sections with exceptionally difficult terrain, as appropriate to each case.
2/ Right-of-way width increased to 42 m where designed to accomodate ultimate construction of 4-lane divided highway.
3/ Pavement designed for the projected number of repetitions of "equivalent 18,000 lbs axle-loads."
4/ Depending on traffic volumes.
5/ Right-of-way width reduced to 20 m where necessary to minimize demolition of property in urban areas.
6/ Existing bridges retained unless significantly substandard in strength, size, or alignment.

Sources: Ministry of Construction, and consultants Wilbur Smith/Louis Berger/Kampsax

January 1976

Table 11

KOREA

Third Highway Project

MOC Field Organization for Maintenance of National Highways
Implementation Schedule

	Action	Implementation Date
1.	Prepare, with assistance of consultants, a detailed program and time schedule for implementing the establishment of the MOC field organization.	April 30, 1975
2.	Publish Ministerial Decree authorizing the setting up of 17 MOC Field Sections (Districts) for remaining 8 provinces. 1/	June 18, 1975
3.	Invite international bids for maintenance and workshop equipment for 2 above.	June 30, 1975
4.	Evaluate international bids for maintenance and workshop equipment, and award contracts for supply.	December 8, 1975
5.	Complete construction of Offices and workshops for the Field Sections in 2 above.	March 1, 1976
6.	Complete transfer, and recruitment of staff for Field Sections; provide funds, and take over maintenance of national highways in the remaining 8 provinces.	March 1, 1976
7.	Complete delivery of maintenance and workshop equipment and complete take over of responsibility for National Highways.	October 1, 1976

1/ MOC Maintenance Organization for national highways (2 Field Sections) in the "pilot" province of Gyeonggi-do was set up and became operational September 1, 1972. The Field Sections have recently been renamed National Highway Maintenance Offices (NHMO's).

SOURCE: Ministry of Construction

January 1976

KOREA

Table 12

THIRD HIGHWAY PROJECT

Estimated Cost of Project

Item	Length (km)	Won (million) Local	Foreign	Total	US$ (million) Local	Foreign	Total	% Foreign Exchange Component
A. Highway Construction								
1. Seoul (Seongnam) -Icheon	43	4,533	3,709	8,242	9.3	7.7	17.0	
2. Daegu-Masan	85	10,634	8,700	19,334	21.9	17.9	39.8	
3. Pohang-Yeongdeog	45	2,940	2,405	5,345	6.1	5.0	11.0	
4. Suncheon-Beolgyo	22	1,619	1,325	2,944	3.3	2.7	6.1	
Subtotal A	195	19,726	16,139	35,865	40.6	33.3	73.9	45
B. Highway Paving								
1. Icheon-Judeog	53	1,828	1,495	3,323	3.8	3.1	6.9	
2. Chungju-Gimcheon	103	4,046	3,310	7,356	8.3	6.8	15.2	
3. Maepo-Andong	87	3,386	2,770	6,156	7.0	5.7	12.7	
4. Weonju-Hayeong	40	1,402	1,148	2,550	2.9	2.4	5.3	
5. Yeongdeog-Uljin	76	2,490	2,037	4,527	5.1	4.2	9.3	
6. Uljin-Samcheog	71	2,254	1,845	4,099	4.6	3.8	8.4	
7. Beolgyo-Gangjin	67	1,530	1,252	2,782	3.2	2.6	5.7	
8. Seongjeon-Mogpo	40	728	596	1,324	1.5	1.2	2.7	
9. Sangju-Gasan	64	1,536	1,257	2,793	3.2	2.6	5.8	
Subtotal B	601	19,200	15,710	34,910	39.6	32.4	72.0	45
C. Consultants' Services								
1. Supervision		2,716	1,164	3,880	5.6	2.4	8.0	30
2. Feasibility Studies for improvement/paving of about 1,200 km of roads, to be followed by detailed engineering, if found justified		1,115	485	1,600	2.3	1.0	3.3	30
Subtotal C		3,831	1,649	5,480	7.9	3.4	11.3	30
D. Contingency Allowances								
1. Physical 1/		4,275	3,350	7,625	8.8	6.9	15.7	
2. Price 2/		8,640	6,780	15,420	17.8	14.0	31.8	
Subtotal D		12,915	10,130	23,045	26.6	20.9	47.5	
Total Cost of Works		55,672	43,628	99,300	114.7	90.0	204.7	44
E. Right of Way		7,760	-	7,760	16.0	-	16.0	
Total Cost of Project		63,432	43,628	107,060	130.7	90.0	220.7	41

1/ 10% on all items

2/ Price escalation assumed to be at the annual rates of 12% in 1976 and 10% during each year thereafter, for both foreign and local costs.

Sources: Ministry of Construction and Consultants' Estimates

January 1976

Table 13

KOREA

THIRD HIGHWAY PROJECT

Project Implementation Schedule

	Action	Time for Implementation (in months from date of Loan signature)
1.	Construction and Paving of Highways	
	(a) Invite bids for construction of two highway sections, and for paving four highway sections.	-1
	(b) Invite bids for construction of remaining two highway sections and for paving remaining five highway sections.	-½
	(c) Receive bids for (a).	2
	(d) Receive bids for (b).	2½
	(e) Acquire right of way for all highway sections.	4
	(f) Appoint consultants and KHC for supervision of construction and paving, in consultation with the Bank.	3
	(g) Evaluation of bids by consultants, recommendations of Government for selection of successful bidders, and award of all contracts (in agreement with the Bank).	4
	(h) Completion of contracts for construction and paving.	40
2.	Feasibility Studies of Roads, Followed by Detailed Engineering if Found to Be Feasible	
	(a) Agree Terms of Reference, and list of Consultants, with the Bank, and invite consultants to submit proposals.	10
	(b) Evaluate proposals, and negotiate contract (or contracts) with selected firm or firms, in agreement with the Bank.	14
	(c) Complete Feasibility Studies draft Final Reports.	23
	(d) Select roads for detailed engineering, in agreement with Bank.	25
	(e) Start Detailed Engineering.	26
	(f) Complete Detailed Engineering.	33

Source: Government/Bank Estimates

January 1976

Table 14

KOREA

THIRD HIGHWAY PROJECT

Schedule of Estimated Disbursements

IBRD Fiscal Year and Quarter	Cumulative Disbursements at End of Quarter (US$ '000)
1975/76	
March 31, 1976	--
June 30, 1976	200
1976/77	
September 30, 1976	6,000
December 31, 1976	11,000
March 31, 1977	15,000
June 30, 1977	20,000
1977/78	
September 30, 1977	30,000
December 31, 1977	40,000
March 31, 1978	48,000
June 30, 1978	60,000
1978/79	
September 30, 1978	68,000
December 31, 1978	78,000
March 31, 1979	83,000
June 30, 1979	87,000
1979/80	
September 30, 1979	89,000
December 31, 1979	90,000

Source: Government/Bank Estimate

January 1976

KOREA

THIRD HIGHWAY PROJECT

Traffic Volumes on Project Roads

	Road Length Km	Average Annual Daily Traffic 1975 Range	1975 Weighted Average	Forecast 1/ 1978	1987	1997	Average Estimated Traffic Growth (% p.a.) 1978-1997
A. Highway Construction							
1. Seoul (Seongnam)-Icheon	42.7	80-920	418	2,024	4,404	10,643	9.1
2. Daegu-Masan	84.5	472-1850	625	1,864	4,358	11,218	9.9
3. Pohang-Yeongdeog	44.7	336-609	510	858	1,865	4,494	9.1
4. Suncheon-Beolgyo	21.8	340-420	374	564	1,197	2,763	8.8
B. Highway Paving							
1. Icheon-Judeog	53.1	360-640	479	749	1,578	3,668	8.7
2. Chungju-Gimcheon	102.6	350-600	543	841	1,747	3,977	8.5
3. Maepo-Andong	86.5	260-442	357	563	1,140	2,517	8.2
4. Weonju-Hayeong	39.6	200-500	258	468	984	2,262	8.7
5. Yeongdeog-Uljin	76.2	416-483	449	681	1,440	3,349	8.7
6. Uljin-Samcheog	71.2	147-425	199	300	626	1,441	8.6
7. Beolgyo-Gangjin	66.7	225-420	236	336	720	1,678	8.8
8. Seongjeon-Mogpo	39.6	180-540	252	362	773	1,817	8.9
9. Sangju-Gasan	63.7	140-235	193	303	647	1,525	8.9

1/ Traffic forecasts include, in addition to generated traffic, the traffic diverted from existing highways and from railways; the volume diverted from railways ranges from 2.1 to 17.0 percent of total traffic with an average of about 5 percent in 1978.

Table 15

Sources: Consultants' and Mission Estimates.

January 1976

Table 16

KOREA

THIRD HIGHWAY PROJECT

Estimated Traffic Growth on Project Roads
(% p.a.)

		Normal Growth (1975-97)			Generated Growth (1978)
A.	Highway Construction	Cars	Buses	Trucks	All Vehicles
	1. Seoul (Seongnam)-Icheon	6.5	10.1	9.7	21.4
	2. Daegu-Masan	9.5	10.4	9.9	22.5
	3. Pohang-Yeongdeog	8.5	10.5	8.3	30.8
	4. Suncheon-Beolgyo	9.2	9.5	8.2	17.5
B.	Highway Paving				
	1. Icheon-Judeog	7.8	10.5	7.8	12.2
	2. Chungju-Gimcheon	7.8	10.5	7.8	12.0
	3. Maepo-Andong	7.8	10.5	7.8	13.7
	4. Weonju-Hayeong	7.8	10.5	7.8	13.2
	5. Yeongdeog-Uljin	7.6	10.0	6.9	19.5
	6. Uljin-Samcheog	7.6	10.0	6.9	17.6
	7. Beolgyo-Gangjin	9.2	9.5	8.2	11.6
	8. Seongjeon-Mogpo	9.2	9.5	8.2	12.4
	9. Sangju-Gasan	7.8	10.5	7.8	9.2

Sources: Consultant's Estimates

January 1976

KOREA

THIRD HIGHWAY PROJECT

Estimated Average Vehicle Operating Costs and Savings on Project Roads
(Won per km, excluding tax and passenger time savings)

	Light Vehicles				Taxis				Buses				Trucks			
	Existing Road	Improved Road	Savings Per km.	%	Existing Road	Improved Road	Savings Per km.	%	Existing Road	Improved Road	Savings Per km.	%	Existing Road	Improved Road	Savings Per km.	%
A. Highway Construction																
1. Seoul (Seongnam)-Icheon	85.0	36.6	48.4	57	80.2	34.6	45.6	57	182.6	95.3	87.3	48	155.1	84.2	70.9	46
2. Daegu-Masan	92.1	36.0	56.1	61	87.0	34.0	53.0	61	200.0	89.2	110.8	55	171.3	78.8	92.5	54
3. Pohang-Yeongdeog	73.5	39.5	34.0	46	69.4	37.3	32.1	46	174.9	101.1	73.8	42	182.4	96.4	86.0	47
4. Suncheon-Beolgyo	73.9	39.0	34.9	47	69.7	36.8	32.9	47	180.4	102.4	78.0	43	175.7	88.7	87.0	50
B. Highway Paving																
1. Icheon-Judeog	78.5	42.9	35.6	45	74.1	40.5	33.6	45	167.3	107.1	60.2	36	140.7	97.6	43.1	31
2. Chungju-Gimcheon	81.0	46.8	34.2	42	76.5	44.1	32.4	42	176.0	118.8	57.2	33	148.1	106.8	41.3	28
3. Maepo-Andong	80.3	47.0	33.3	42	75.8	44.4	31.4	42	174.8	127.1	47.7	27	149.6	116.6	33.0	22
4. Weonju-Hayeong	77.4	46.4	31.0	40	73.0	43.8	29.2	40	170.5	118.1	52.4	31	150.8	106.3	44.5	30
5. Yeongdeog-Uljin	71.1	46.6	24.5	35	67.1	44.0	23.1	35	175.5	119.2	56.3	32	168.8	108.8	60.0	36
6. Uljin-Samcheog	70.8	51.6	19.2	27	66.8	48.7	18.1	27	176.8	132.3	44.5	25	171.0	122.6	48.4	28
7. Beolgyo-Gangjin	60.5	43.9	16.6	27	57.1	41.4	15.7	27	147.7	110.3	37.4	25	140.2	99.4	40.8	29
8. Seongjeon-Mogpo	58.9	42.5	16.4	28	55.6	40.1	15.5	28	145.0	105.2	39.8	27	129.6	95.0	34.6	27
9. Sangju-Gasan	70.8	45.6	25.2	36	66.8	43.1	23.7	36	150.1	111.8	38.3	26	132.0	100.0	32.0	24

Sources: Consultant's and Mission Estimates.

January 1976

Table 17

KOREA

THIRD HIGHWAY PROJECT

Estimated Costs and Benefits Streams
(million Won excluding taxes)

New Construction

1. Seoul (Seongnam)-Icheon
Asphaltic Concrete

	Costs				Benefits			
	Construction, Right of Way and	Maintenance Gravel Existing	Paved New		Operating Cost Savings		Net Benefits	
Year	Supervision (1)	Road (2)	Road (3)	Total Cost (4)=(1)+(3)-(2)	Without Time (5)	With Time (6)	Without Time (7)=(5)-(4)	With Time (8)=(6)-(4)
1976	3,729.24							
1977	3,729.24							
1978		150.01	47.57	-102.44	1,002.03	1,132.29	1,104.47	1,234.73
1979		134.94	48.86	-116.08	1,096.35	1,238.88	1,212.43	1,354.96
1980		179.28	50.29	-128.99	1,199.68	1,355.64	1,328.67	1,484.63
1981		196.08	51.85	-144.23	1,312.85	1,483.52	1,457.08	1,627.75
1982		214.53	53.55	-160.98	1,436.86	1,623.65	1,597.84	1,784.63
1983		234.76	55.43	-179.33	1,572.75	1,777.21	1,752.08	1,956.54
1984		256.97	57.48	-199.49	1,722.67	1,946.62	1,922.16	2,146.11
1985		281.35	59.73	-221.62	1,884.89	2,129.93	2,106.51	2,351.55
1986		303.09	62.21	-245.88	2,063.37	2,332.17	2,309.75	2,578.05
1987		337.46	64.91	-272.55	2,259.30	2,553.57	2,532.35	2,826.22
1988		369.69	67.90	-301.79	2,474.69	2,796.40	2,776.48	3,098.19
1989		405.06	71.16	-333.92	2,710.27	3,062.61	3,044.19	3,396.53
1990		443.90	74.73	-369.17	2,968.51	3,354.42	3,337.63	3,723.59
1991		486.53	78.67	-407.86	3,251.62	3,674.33	3,659.43	4,082.19
1992		533.32	82.97	-450.35	3,562.03	4,025.09	4,012.38	4,475.44
1993		584.69	87.70	-496.99	3,902.39	4,409.70	4,399.38	4,906.69
1994		641.05	92.90	-548.15	4,275.90	4,831.77	4,825.05	5,379.92
1995		702.97	98.59	-604.38	4,685.11	5,294.17	5,289.49	5,898.55
1996		770.91	104.83	-666.08	5,133.63	5,801.00	5,799.71	6,467.08
1997		845.50	111.68	-733.82	5,625.82	6,357.18	6,359.64	7,091.00
1998	-1,864.62							
							IRR=21.2	IRR=23.0

SOURCES: Consultants' and Mission' Estimates.

January 1976

KOREA

THIRD HIGHWAY PROJECT

Estimated Costs and Benefits Streams
(million Won excluding taxes)

New Construction

2. Daegu-Masan
Asphaltic Concrete

	Costs				Benefits			
	Construction, Right of Way and	Maintenance Gravel Existing	Paved New		Operating Cost Savings		Net Benefits	
Year	Supervision (1)	Road (2)	Road (3)	Total Cost (4)=(1)+(3)-(2)	Without Time (5)	With Time (6)	Without Time (7)=(5)-(4)	With Time (8)=(6)-(4)
1976	9,189.68							
1977	9,199.69							
1978		335.67	141.44	-194.23	5,159.39	5,623.74	5,353.62	5,817.97
1979		365.24	145.43	-219.81	5,673.89	6,184.54	5,893.70	6,404.35
1980		397.75	149.87	-247.88	6,239.72	6,801.30	6,487.60	7,049.18
1981		433.57	154.70	-278.87	6,362.03	7,479.61	7,140.90	8,594.51
1982		472.94	160.01	-312.93	7,546.46	8,225.64	7,859.39	8,538.57
1983		516.26	165.89	-350.37	8,299.25	9,046.18	8,649.62	9,396.55
1984		563.91	172.33	-391.58	9,127.12	9,948.56	9,519.70	10,340.14
1985		631.16	179.40	-451.76	10,037.75	10,941.15	10,489.51	11,392.91
1986		674.03	187.20	-486.83	11,039.23	12,032.76	11,526.06	12,519.59
1987		737.47	195.78	-541.69	12,140.73	13,233.40	12,682.42	13,775.09
1988		807.31	205.19	-602.12	13,352.28	14,553.99	13,954.40	15,156.11
1989		884.12	217.04	-667.08	14,681.76	16,006.39	15,351.34	16,678.47
1990		960.63	220.58	-740.05	16,150.37	17,603.90	16,890.42	18,343.95
1991		1,061.58	241.26	-820.30	17,762.33	19,360.94	18,582.63	20,181.24
1992		1,163.68	255.25	-1021.16	19,535.36	21,293.54	20,556.32	22,314.70
1993		1,276.41	270.63	-1005.78	21,485.51	23,419.21	22,491.29	24,424.99
1994		1,400.23	287.52	-1667.75	23,630.50	25,757.25	25,318.25	27,445.00
1995		1,536.42	306.09	-1230.33	25,989.85	28,328.94	27,220.18	29,559.27
1996		1,686.28	326.52	-1359.76	28,584.08	31,157.52	29,544.64	32,517.28
1997		1,851.19	349.09	-1502.19	31,439.33	34,268.87	32,941.52	35,771.06
1998	-4,594.84							
							IRR=34.5	IRR=36.7

SOURCES: Consultants' and Mission' Estimates.

January 1976

KOREA

THIRD HIGHWAY PROJECT

Estimated Costs and Benefits Streams
(million Won excluding taxes)

New Construction

3. Pohang-Yeongdeog
Asphaltic Concrete

	Costs				Benefits			
	Construction, Right of Way and	Maintenance			Operating Cost Savings		Net Benefits	
Year	Supervision (1)	Gravel Existing Road (2)	Paved New Road (3)	Total Cost (4)=(1)+(3)-(2)	Without Time (5)	With Time (6)	Without Time (7)=(5)-(4)	With Time (8)=(6)-(4)
1976	2,583.70							
1977	2,583.70							
1978		163.77	54.42	-109.35	868.01	998.21	977.36	1,107.56
1979		177.52	55.80	-121.72	946.77	1,088.79	1,068.49	1,210.51
1980		192.54	57.30	-135.24	1,032.77	1,187.69	1,168.01	1,322.93
1981		208.93	58.95	-149.98	1,126.68	1,295.68	1,276.66	1,445.66
1982		226.82	60.75	-166.07	1,229.23	1,413.62	1,395.30	1,579.69
1983		246.36	62.71	-183.65	1,341.23	1,542.42	1,524.88	1,726.07
1984		267.71	64.85	-202.86	1,463.59	1,683.13	1,666.45	1,885.99
1985		291.01	67.20	-223.81	1,597.23	1,836.82	1,821.04	2,060.63
1986		316.46	69.75	-246.71	1,743.24	2,004.73	1,980.95	2,251.44
1987		344.28	72.55	-271.73	1,902.79	2,188.21	2,174.52	2,459.94
1988		374.65	75.59	-299.06	2,077.11	2,388.68	2,376.17	2,687.74
1989		407.85	78.94	-328.91	2,267.61	2,607.75	2,596.52	2,936.66
1990		444.12	82.58	-361.54	2,475.83	2,847.21	2,837.37	3,208.75
1991		483.75	86.57	-397.18	2,703.41	3,108.92	3,100.59	3,506.10
1992		527.06	90.92	-436.14	2,952.19	3,395.02	3,388.33	3,831.16
1993		574.41	95.69	-478.72	3,224.16	3,707.78	3,702.88	4,186.50
1994		626.16	100.89	-525.27	3,521.52	4,079.75	4,048.79	4,605.02
1995		682.74	106.59	-576.15	3,846.65	4,423.65	4,422.80	4,999.80
1996		744.59	112.81	-631.78	4,202.23	4,832.57	4,834.01	5,464.35
1997		812.22	119.63	-692.59	4,591.01	5,279.66	5,283.60	5,972.25
1998	-1,291.85							
							IRR=24.9	IRR=27.2

SOURCES: Consultants' and Mission' Estimates.

January 1976

KOREA

THIRD HIGHWAY PROJECT

Estimated Costs and Benefits Streams
(million Won excluding taxes)

New Construction

4. Suncheon-Beolgyo
Asphaltic Concrete

	Costs				Benefits			
	Construction, Right of Way and	Maintenance Gravel	Paved		Operating Cost Savings		Net Benefits	
Year	Supervision (1)	Existing Road (2)	New Road (3)	Total Cost (4)=(1)+(3)-(2)	Without Time (5)	With Time (6)	Without Time (7)=(5)-(4)	With Time (8)=(6)-(4)
1976	1,396.56							
1977	1,396.56							
1978		66.93	24.30	-42.63	319.40	370.50	362.03	413.13
1979		72.44	24.73	-47.71	347.06	402.59	394.77	450.30
1980		78.41	25.25	-53.16	377.11	437.45	430.27	490.61
1981		84.90	25.70	-59.20	409.79	475.36	468.99	534.56
1982		91.95	26.25	-65.70	445.31	516.96	511.01	582.66
1983		99.61	26.85	-72.76	483.93	561.36	556.69	634.12
1984		107.93	27.49	-80.44	525.98	610.04	606.34	690.48
1985		116.97	28.20	-88.77	571.54	662.99	660.31	751.76
1986		126.80	28.97	-97.83	621.14	720.52	718.97	818.35
1987		137.47	29.80	-107.67	675.07	783.08	782.74	890.75
1988		146.22	30.71	-115.51	733.72	851.12	843.23	966.63
1989		161.66	31.70	-129.96	797.48	925.08	927.44	1,055.04
1990		175.35	32.76	-142.59	866.79	1,005.48	1,009.38	1,148.07
1991		187.37	33.94	-153.43	942.19	1,092.94	1,095.62	1,246.37
1992		206.38	35.21	-171.17	1,024.16	1,188.03	1,195.33	1,359.20
1993		223.94	36.59	-187.35	1,113.27	1,291.39	1,300.62	1,478.74
1994		243.02	38.09	-204.93	1,210.19	1,403.82	1,415.12	1,608.75
1995		263.76	39.72	-224.04	1,315.59	1,526.08	1,539.63	1,750.12
1996		286.30	41.50	-244.80	1,430.20	1,659.03	1,675.00	1,903.83
1997		310.79	43.44	-267.35	1,554.82	1,803.59	1,822.17	2,070.94
1998	-698.28							
							IRR=18.5	IRR=20.5

SOURCES: Consultants' and Mission' Estimates.

January 1976

KOREA

THIRD HIGHWAY PROJECT

Estimated Costs and Benefits Streams
(million Won excluding taxes)

Paving and Upgrading

1. Icheon-Judeog

Asphaltic Concrete

	Costs				Benefits			
	Construction, Right of Way and	Maintenance Gravel	Paved		Operating Cost Savings		Net Benefits	
Year	Supervision (1)	Existing Road (2)	New Road (3)	Total Cost (4)=(1)+(3)-(2)	Without Time (5)	With Time (6)	Without Time (7)=(5)-(4)	With Time (8)=(6)-(4)
1976	1,426.49							
1977	1,426.48							
1978		188.43	62.54	-125.89	626.32	732.79	752.21	858.68
1979		204.69	64.31	-140.38	681.76	797.66	822.14	938.04
1980		222.40	66.23	-156.17	742.19	868.36	898.36	1,024.53
1981		241.69	68.32	-173.37	808.11	945.49	981.48	1,118.86
1982		262.69	70.59	-192.10	880.03	1,029.64	1,072.13	1,221.74
1983		285.57	73.07	-212.50	958.48	1,121.42	1,170.98	1,333.92
1984		310.47	75.76	-234.71	1,044.09	1,221.59	1,278.80	1,456.30
1985		337.59	78.71	-258.88	1,137.51	1,330.89	1,396.39	1,589.77
1986		367.13	81.91	-285.22	1,239.48	1,450.19	1,524.70	1,735.41
1987		399.30	85.40	-313.90	1,350.79	1,580.42	1,664.69	1,894.32
1988		434.33	89.18	-345.15	1,472.30	1,722.59	1,817.45	2,067.74
1989		472.48	93.32	-379.16	1,604.99	1,877.84	1,984.15	2,257.00
1990		514.03	97.82	-416.21	1,749.92	2,047.41	2,166.13	2,463.62
1991		559.26	102.72	-456.54	1,908.21	2,232.61	2,364.75	2,689.15
1992		608.53	108.06	-500.47	2,081.15	2,434.95	2,581.62	2,935.42
1993		662.18	113.86	-548.32	2,270.10	2,656.02	2,818.42	3,204.34
1994		720.61	120.19	-600.42	2,476.57	2,897.59	3,076.99	3,498.01
1995		784.24	127.08	-657.16	2,702.25	3,161.63	3,359.41	3,818.79
1996		853.53	134.60	-718.93	2,948.94	3,450.26	3,667.87	4,169.19
1997		928.98	142.77	-786.21	3,218.65	3,765.82	4,004.86	4,552.03
1998	-713.24							
							IRR=31.4	IRR=34.5

SOURCES: Consultants' and Mission's Estimates.

January 1976

KOREA

THIRD HIGHWAY PROJECT

Estimated Costs and Benefits Streams
(million Won excluding taxes)

Paving and Upgrading

2. Chungju-Gimcheon
Asphaltic Concrete

	Costs				Benefits			
	Construction, Right of Way and	Maintenance Gravel	Paved		Operating Cost Savings		Net Benefits	
Year	Supervision (1)	Existing Road (2)	New Road (3)	Total Cost (4)=(1)+(3)-(2)	Without Time (5)	With Time (6)	Without Time (7)=(5)-(4)	With Time (8)=(6)-(4)
1976	3,345.74							
1977	3,345.74							
1978		483.70	160.76	-322.94	1,584.58	1,901.50	1,907.52	2,224.44
1979		523.79	165.77	-358.02	1,721.59	2,065.91	2,079.61	2,423.93
1980		567.93	171.22	-396.71	1,870.70	2,244.84	2,267.41	2,641.55
1981		615.89	177.15	-438.74	2,033.00	2,439.60	2,471.74	2,878.34
1982		668.01	183.60	-484.41	2,209.67	2,651.60	2,694.08	3,136.01
1983		724.64	190.60	-534.04	2,402.03	2,882.44	2,936.07	3,416.48
1984		786.17	198.21	-587.96	2,611.51	3,133.81	3,199.47	3,721.77
1985		853.04	206.48	-646.56	2,839.61	3,407.53	3,486.17	4,054.09
1986		925.69	215.47	-710.22	3,088.09	3,705.71	3,798.31	4,415.93
1987		1,004.61	225.28	-779.33	3,358.81	4,030.57	4,138.14	4,809.90
1988		1,090.40	235.84	-854.56	3,653.75	4,384.50	4,058.31	5,239.06
1989		1,183.58	247.35	-936.23	3,975.16	4,770.19	4,911.39	5,706.42
1990		1,284.26	259.89	-1024.37	4,325.46	5,190.55	5,349.83	6,214.92
1991		1,394.91	273.50	-1121.41	4,707.31	5,648.77	5,828.72	6,770.18
1992		1,514.48	288.28	-1226.20	5,123.62	6,148.34	6,349.82	7,374.54
1993		1,644.41	304.35	-1340.06	5,481.33	6,577.60	6,821.39	7,917.66
1994		1,785.58	321.83	-1463.75	6,072.61	7,287.13	7,536.36	8,750.88
1995		1,938.99	340.82	-1598.17	6,612.58	7,935.10	8,210.75	9,533.27
1996		2,105.70	361.45	-1744.25	7,201.60	8,641.92	8,945.85	10,386.17
1997		2,286.83	383.86	-1902.97	7,844.27	9,413.12	9,747.24	10,506.09
1998	-1,672.87							
							IRR=32.9	IRR=36.7

SOURCES: Consultants' and Mission's Estimates.

January 1976

KOREA

THIRD HIGHWAY PROJECT

Estimated Costs and Benefits Streams
(million Won excluding taxes)

Paving and Upgrading

3.Maepo-Andong
Asphaltic Concrete

	Costs				Benefits			
	Construction, Right of Way and	Maintenance Gravel	Paved		Operating Cost Savings		Net Benefits	
Year	Supervision (1)	Existing Road (2)	New Road (3)	Total Cost (4)=(1)+(3)-(2)	Without Time (5)	With Time (6)	Without Time (7)=(5)-(4)	With Time (8)=(6)-(4)
1976	2,735.65							
1977	2,735.65							
1978		249.21	92.22	-156.99	678.46	787.01	835.45	944.09
1979		269.17	94.90	-174.27	734.60	852.14	908.87	1,026.41
1980		290.88	97.79	-193.01	795.45	922.72	988.46	1,115.73
1981		314.23	100.94	-213.29	861.43	999.26	1,074.72	1,212.55
1982		339.60	104.34	-235.26	932.97	1,082.25	1,168.23	1,317.51
1983		367.08	108.02	-259.06	1,010.55	1,172.24	1,269.61	1,431.30
1984		396.85	112.02	-284.83	1,094.66	1,269.81	1,379.49	1,554.64
1985		429.10	116.32	-312.78	1,185.89	1,375.63	1,498.67	1,688.41
1986		464.03	121.00	-343.03	1,284.88	1,490.46	1,627.91	1,833.49
1987		501.89	126.07	-375.82	1,392.25	1,615.01	1,768.07	1,990.83
1988		542.90	131.54	-411.36	1,508.76	1,750.16	1,920.12	2,161.52
1989		587.32	137.47	-449.85	1,635.19	1,896.82	2,085.04	2,346.67
1990		635.49	143.91	-491.58	1,772.39	2,055.97	2,263.97	2,547.55
1991		687.64	150.86	-536.78	1,921.30	2,228.71	2,458.08	2,765.49
1992		744.17	158.92	-585.25	2,082.94	2,416.21	2,668.19	3,001.46
1993		805.42	166.56	-638.86	2,258.43	2,619.78	2,897.29	3,258.64
1994		871.80	175.40	-696.40	2,448.98	2,840.81	3,145.38	3,537.21
1995		943.74	184.98	-758.76	2,655.91	3,080.86	3,414.67	3,839.62
1996		1,021.69	195.35	-826.34	2,880.64	3,341.54	3,706.98	4,167.88
1997		1,106.20	206.59	-899.61	3,124.76	3,624.72	4,024.37	4,524.33
1998	-1,367.82							
							IRR=20.8	IRR=22.7

SOURCES: Consultants' and Mission's Estimates.

January 1976

KOREA

THIRD HIGHWAY PROJECT

Estimated Costs and Benefits Streams
(million Won excluding taxes)

Paving and Upgrading

4. Weonju-Hayeong
Asphaltic Concrete

	Costs				Benefits			
	Construction, Right of Way and	Maintenance Gravel Existing	Paved New	Total	Operating Cost Savings Without	With	Net Benefits Without	With
Year	Supervision (1)	Road (2)	Road (3)	Cost (4)=(1)+(3)-(2)	Time (5)	Time (6)	Time (7)=(5)-(4)	Time (8)=(6)-(4)
1976	1,125.65							
1977	1,125.65							
1978		76.28	45.80	-30.48	247.66	294.72	278.14	325.20
1979		82.61	47.03	-35.58	269.51	320.72	305.09	356.30
1980		89.51	48.37	-41.14	293.32	349.05	334.46	390.19
1981		97.01	49.82	-47.19	319.30	379.97	366.49	427.16
1982		105.17	51.41	-53.76	347.62	413.67	401.38	467.43
1983		114.06	53.13	-60.93	378.51	450.43	433.44	511.36
1984		123.72	55.01	-68.71	412.22	490.54	480.93	559.25
1985		134.24	57.04	-77.20	448.98	534.29	526.18	611.49
1986		145.68	59.26	-86.42	489.49	582.49	575.91	668.91
1987		158.13	61.68	-96.45	532.87	634.12	628.32	730.57
1988		171.67	64.31	-107.36	580.67	691.00	688.03	798.36
1989		186.40	67.17	-119.23	632.84	753.08	752.07	872.31
1990		202.43	70.27	-132.16	689.79	820.85	821.95	953.01
1991		219.87	73.67	-146.20	751.99	894.87	898.19	1,041.07
1992		238.84	77.35	-161.49	819.93	975.72	981.42	1,137.21
1993		259.49	81.35	-178.14	894.14	1,064.03	1,072.28	1,242.17
1994		281.95	85.71	-196.24	975.21	1,160.50	1,171.45	1,356.74
1995		306.36	90.45	-215.93	1,063.80	1,265.92	1,279.72	1,481.85
1996		332.98	95.61	-237.37	1,160.61	1,381.13	1,397.98	1,618.50
1997		361.90	101.22	-260.68	1,266.43	1,507.05	1,527.11	1,767.73
1998	-562.83							
							IRR=18.3	IRR=20.6

SOURCES: Consultants' and Mission's Estimates.

January 1976

KOREA

THIRD HIGHWAY PROJECT

Estimated Costs and Benefits Streams
(million Won excluding taxes)

Paving and Upgrading

5. Yeongdeog-Uljin
Asphaltic Concrete

	Costs				Benefits			
	Construction Right of Way and	Maintenance Gravel Existing	Paved New		Operating Cost Savings Without	With	Net Benefits Without	With
Year	Supervision (1)	Road (2)	Road (3)	Total Cost (4)=(1)+(3)-(2)	Time (5)	Time (6)	Time (7)=(5)-(4)	Time (8)=(6)-(4)
1976	2,035.09							
1977	2,035.09							
1978		263.83	127.12	-136.71	969.07	1,115.16	1,105.78	1,251.87
1979		285.47	131.17	-154.30	1,052.16	1,209.98	1,206.46	1,364.28
1980		309.51	135.57	-173.94	1,142.36	1,313.71	1,316.30	1,487.65
1981		334.46	140.34	-194.12	1,240.66	1,426.76	1,434.78	1,620.88
1982		362.13	145.53	-216.60	1,347.64	1,549.79	1,564.24	1,766.39
1983		392.17	151.15	-241.02	1,464.13	1,683.75	1,705.15	1,924.77
1984		424.79	157.25	-267.54	1,591.01	1,829.66	1,858.55	2,097.20
1985		460.18	163.88	-296.30	1,729.38	1,988.79	2,025.68	2,285.09
1986		498.61	171.07	-827.54	1,879.94	2,161.93	2,707.48	2,989.47
1987		540.31	178.88	-361.43	2,044.15	2,350.77	2,405.58	2,712.20
1988		585.59	187.36	-398.23	2,222.84	2,556.27	2,621.07	2,954.50
1989		634.73	196.56	-438.17	2,417.93	2,780.62	2,856.10	3,218.79
1990		688.07	206.54	-481.53	2,630.55	3,025.13	3,112.08	3,506.66
1991		745.97	217.38	-528.59	2,862.30	3,291.65	3,390.89	3,820.24
1992		808.83	229.15	-579.68	3,115.27	3,582.56	3,694.95	4,162.24
1993		877.05	241.92	-635.13	3,390.80	3,899.42	4,025.93	4,534.55
1994		951.11	255.79	-695.32	3,691.70	4,245.46	4,387.02	4,940.78
1995		1,031.49	270.84	-760.65	4,020.00	4,623.00	4,780.65	5,383.65
1996		1,118.76	287.18	-831.58	4,378.19	5,034.92	5,209.70	5,866.50
1997		1,213.45	304.90	-908.55	4,769.12	5,484.49	6,393.04	6,393.04
1998	-1,017.55							
							IRR=32.2	IRR=35.0

SOURCES: Consultants' and Mission's Estimates.

January 1976

KOREA

THIRD HIGHWAY PROJECT

Estimated Costs and Benefits Streams
(million Won excluding taxes)

Paving and Upgrading

6. Uljin-Samcheog
DBST

Year	Costs: Construction, Right of Way and Supervision (1)	Costs: Maintenance Gravel Existing Road (2)	Costs: Maintenance Paved New Road (3)	Total Cost (4)=(1)+(3)-(2)	Benefits: Operating Cost Savings Without Time (5)	Benefits: Operating Cost Savings With Time (6)	Net Benefits Without Time (7)=(5)-(4)	Net Benefits With Time (8)=(6)-(4)
1976	1,938.74							
1977	1,938.74							
1978		106.38	127.97	+21.59	252.40	322.95	272.37	342.92
1979		114.56	130.20	+15.65	276.34	352.81	302.98	379.43
1980		123.45	132.62	+9.17	308.32	385.21	336.22	419.11
1981		133.07	135.23	+2.16	330.63	420.52	372.39	462.28
1982		143.52	138.16	-5.36	361.32	458.51	411.55	509.04
1983		154.83	141.18	-13.65	394.77	500.52	454.27	560.02
1984		167.10	144.53	-22.57	431.10	545.83	500.61	615.34
1985		180.39	148.10	-32.29	470.65	595.15	551.04	675.54
1986		194.81	152.08	-42.73	513.63	648.76	605.75	740.88
1987		210.45	156.36	-54.08	560.44	707.13	665.31	812.00
1988		227.41	160.97	-66.44	661.41	770.70	730.13	889.42
1989		245.80	166.01	-79.79	667.05	840.04	800.76	973.75
1990		265.72	171.42	-94.29	727.24	915.14	877.21	1,165.11
1991		287.33	177.33	-110.00	793.00	997.14	960.59	1,164.73
1992		310.77	183.73	-127.04	866.69	1,088.52	1,053.40	1,275.23
1993		336.18	190.63	-145.55	942.65	1,183.74	1,150.11	1,391.20
1994		363.72	198.16	-165.56	1,027.66	1,298.75	1,257.58	1,519.67
1995		393.59	206.30	-187.29	1,120.31	1,405.26	1,374.60	1,659.32
1996		425.96	215.14	-210.82	1,121.28	1,531.16	1,501.97	1,811.85
1997		461.07	224.71	-236.36	1,331.38	1,668.43	1,640.72	1,977.77
1998	-969.37							
							IRR=12.0	IRR=14.5

SOURCES: Consultants' and Mission's Estimates.

January 1976

KOREA

THIRD HIGHWAY PROJECT

Estimated Costs and Benefits Streams
(million Won excluding taxes)

Paving and Upgrading

7. Beolgyo-Gangjin
DBST

	Costs				Benefits			
	Construction, Right of Way and	Maintenance Gravel Existing	Paving New		Operating Cost Savings Without	With	Net Benefits Without	With
Year	Supervision (1)	Road (2)	Road (3)	Total Cost (4)=(1)+(3)-(2)	Time (5)	Time (6)	Time (7)=(5)-(4)	Time (8)=(6)-(4)
1976	1,374.52							
1977	1,374.52							
1978		120.18	92.94	-27.74	258.89	305.26	317.03	363.40
1979		130.19	95.52	-34.67	283.35	333.77	349.78	400.20
1980		141.10	98.32	-42.78	309.95	364.77	385.42	440.24
1981		152.95	101.38	-51.57	338.86	398.47	424.14	483.75
1982		165.84	104.69	-61.15	370.37	435.20	466.33	531.16
1983		179.86	108.28	-71.58	404.59	475.08	512.17	582.66
1984		195.10	112.21	-82.89	441.82	518.48	562.02	638.68
1985		211.67	116.46	-95.21	482.35	565.72	616.28	699.65
1986		229.71	121.09	-108.62	526.43	617.10	675.31	765.98
1987		249.33	126.14	-123.19	574.37	672.98	739.50	838.11
1988		270.64	131.61	-139.03	626.59	733.84	809.37	916.62
1989		293.84	137.59	-156.25	683.40	800.06	885.39	1,002.05
1990		319.05	144.06	-174.99	745.21	872.11	968.09	1,094.39
1991		346.48	151.10	-195.38	812.41	950.43	1,058.02	1,196.04
1992		376.32	158.79	-217.53	885.57	1,035.71	1,155.89	1,306.03
1993		408.75	167.12	-241.63	965.21	1,128.53	1,262.40	1,425.72
1994		444.03	176.19	-267.84	1,051.86	1,229.53	1,378.27	1,555.94
1995		482.39	186.05	-296.34	1,146.14	1,339.42	1,504.33	1,697.61
1996		524.12	196.78	-327.34	1,248.81	1,459.09	1,641.57	1,851.85
1997		569.49	208.45	-361.04	1,360.53	1,589.30	1,790.87	2,019.64
1998	-587.26							
							IRR=17.7	IRR=19.5

SOURCES: Consultants' and Mission's Estimates

January 1976

KOREA

THIRD HIGHWAY PROJECT

Estimated Costs and Benefits Streams
(million Won excluding taxes)

Paving and Upgrading

8. Seongjeon-Mogpo
DEST

	Costs				Benefits			
	Construction, Right of Way and	Maintenance Gravel Existing	Paved New		Operating Cost Savings		Net Benefits	
Year	Supervision (1)	Road (2)	Road (3)	Total Cost (4)=(1)+(3)-(2)	Without Time (5)	With Time (6)	Without Time (7)=(5)-(4)	With Time (8)=(6)-(4)
1976	659.94							
1977	659.94							
1978		79.00	60.10	-18.90	158.38	196.53	192.29	239.44
1979		85.55	61.38	-24.17	173.31	214.81	212.81	264.31
1980		92.68	62.80	-29.98	189.66	234.82	235.23	291.39
1981		100.43	64.32	-36.11	207.85	256.98	279.43	345.56
1982		108.87	65.98	-42.89	226.90	279.96	285.87	352.33
1983		118.04	67.80	-50.24	247.44	305.60	313.62	372.78
1984		128.04	69.77	-58.27	270.26	333.55	345.96	409.25
1985		138.90	71.90	-67.00	295.08	363.95	380.04	448.91
1986		150.73	74.23	-76.50	322.12	397.07	417.16	492.11
1987		163.59	76.77	-86.82	351.59	433.11	457.55	539.11
1988		177.59	79.54	-98.05	383.59	472.35	501.51	590.27
1989		192.82	82.53	-110.29	418.46	515.06	549.37	647.97
1990		209.38	85.81	-123.51	456.42	561.55	601.43	706.56
1991		227.40	89.35	-138.05	497.77	612.19	658.24	772.56
1992		247.02	93.22	-153.80	542.78	667.32	719.87	844.41
1993		268.36	97.42	-170.94	591.79	727.34	787.07	922.68
1994		291.57	181.99	-189.58	645.17	792.71	860.23	1,007.77
1995		316.83	106.97	-209.86	703.29	863.89	939.87	1,100.47
1996		344.30	112.39	-231.91	766.57	941.39	1,026.56	1,201.38
1997		374.21	118.29	-255.92	835.49	1,025.80	1,120.96	1,311.27
1998	-329.97						IRR=21.3	IRR=24.1

SOURCES: Consultants' and Mission's Estimates

January 1976

KOREA

THIRD HIGHWAY PROJECT

Estimated Costs and Benefits Streams
(million Won excluding Taxes)

Paving and Upgrading
9. Sangju-Gasan
DBST

	Costs				Benefits			
		Maintenance			Operating Cost Savings		Net Benefits	
Year	Construction, Right of Way and Supervision (1)	Gravel Existing Road (2)	Paved New Road (3)	Total Cost (4)=(1)+(3)-(2)	Without Time (5)	With Time (6)	Without Time (7)=(5)-(4)	With Time (8)=(6)-(4)
1976	1,363.80							
1977	1,363.80							
1978		97.41	100.12	+2.71	181.23	243.27	211.21	273.25
1979		105.56	102.39	-3.17	199.64	466.87	236.24	303.83
1980		114.54	104.84	-9.70	219.75	293.40	263.68	337.33
1981		124.16	107.53	-16.63	241.49	321.96	293.43	373.70
1982		134.72	110.47	-24.25	265.64	353.14	325.96	413.76
1983		146.24	113.36	-32.88	291.91	387.30	361.30	457.19
1984		158.72	117.13	-41.66	320.40	424.41	400.30	504.31
1985		172.48	120.92	-51.56	351.62	469.04	442.66	556.08
1986		187.40	125.05	-62.35	385.73	509.43	488.91	612.61
1987		203.66	129.56	-74.10	423.02	597.96	539.42	674.36
1988		221.38	134.46	-86.92	463.76	610.98	594.58	741.80
1989		240.70	139.82	-100.88	508.30	668.95	654.83	815.48
1990		261.74	145.64	-116.12	557.00	732.32	720.67	985.99
1991		284.70	152.01	-132.69	610.22	801.59	795.93	1,033.04
1992		309.73	158.93	-150.80	668.49	877.40	871.16	1,080.09
1993		336.99	166.49	-170.50	732.18	960.28	957.04	1,185.14
1994		366.71	174.73	-191.98	801.87	1,050.96	1,050.90	1,299.99
1995		399.12	183.70	-215.42	878.11	1,150.16	1,153.51	1,425.56
1996		434.43	193.47	-240.96	961.55	1,258.72	1,265.68	1,562.85
1997		472.92	204.14	-268.78	1,052.86	1,377.52	1,388.29	1,712.95
1998	-681.90							
							IRR=13.7	IRR=16.5

SOURCES: Consultants' and Mission's Estimates.

January 1976

KOREA

THIRD HIGHWAY PROJECT

Economic Returns and Sensitivity Analyses

(%)

	Best Estimate	High 1/ Estimate	Low 2/ Estimate	Passenger Time Saving Excluded From Benefits
A. Highway Construction				
1. Seoul (Seongnam)-Icheon	23	31	16	21
2. Daegu-Masan	37	53	28	35
3. Pohang-Yeongdeog	27	36	24	25
4. Suncheon-Beolgyo	21	28	14	19
B. Highway Paving				
1. Icheon-Judeog	35	50	26	31
2. Chungju-Gimcheon	37	55	28	33
3. Maepo-Andong	23	31	16	21
4. Weonju-Hayeong	21	28	14	18
5. Yeongdeog-Uljin	35	51	26	32
6. Uljin-Samcheog (DBST)	15	19	10	12
7. Beolgyo-Gangjin (DBST)	20	27	14	18
8. Seongjeon-Mogpo (DBST)	24	33	17	21
9. Sangju-Gasan (DBST)	17	22	12	14

Note: All analyses are for asphaltic concrete (AC) unless otherwise noted.

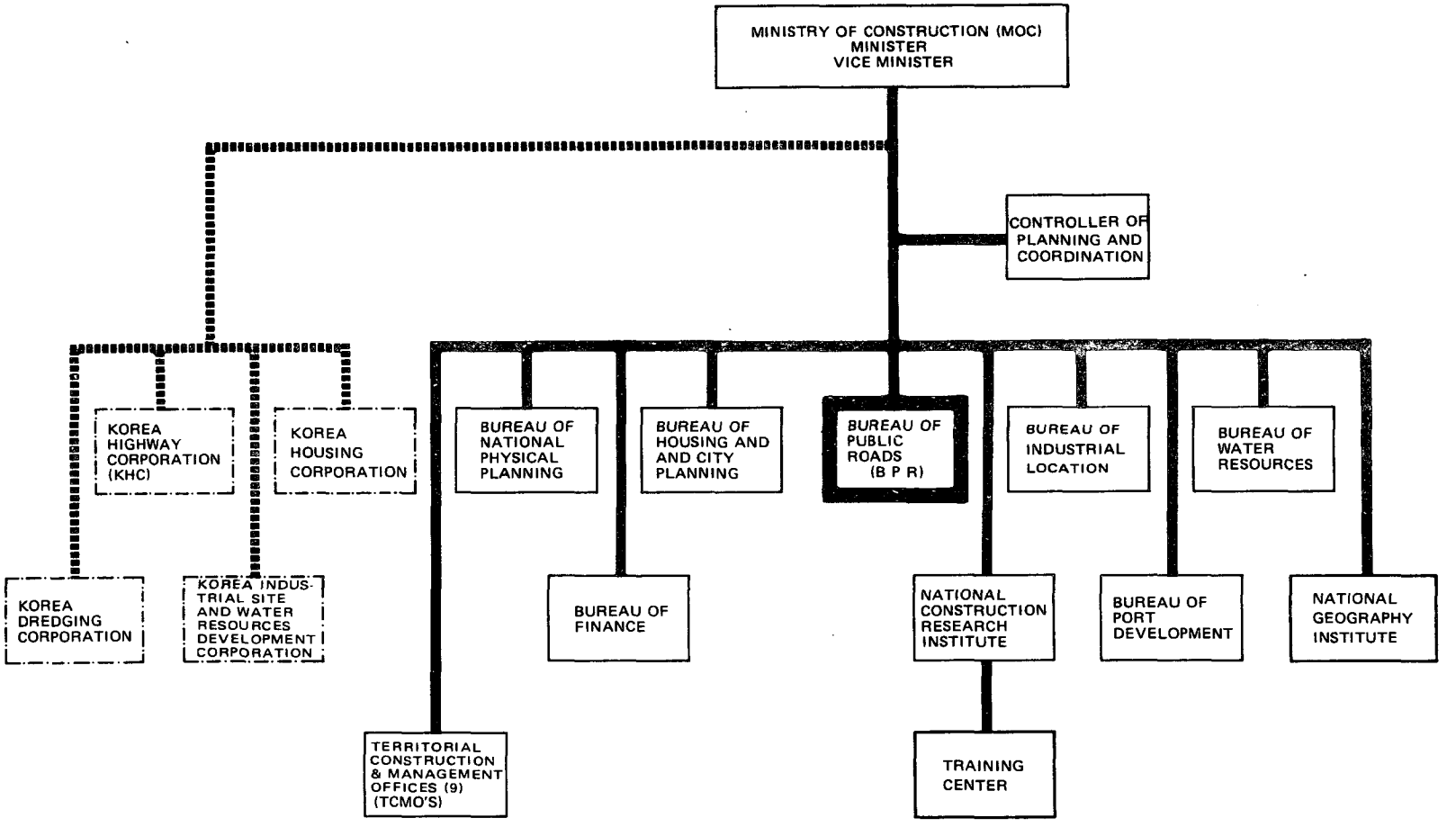
1/ Assumes costs 15% lower and benefits 25% higher than in the best estimate

2/ Assumes costs 15% higher and benefits 25% lower than in the best estimate

Sources: Consultant's and mission Estimates

January 1976

KOREA: THIRD HIGHWAY PROJECT
MINISTRY OF CONSTRUCTION ORGANIZATION

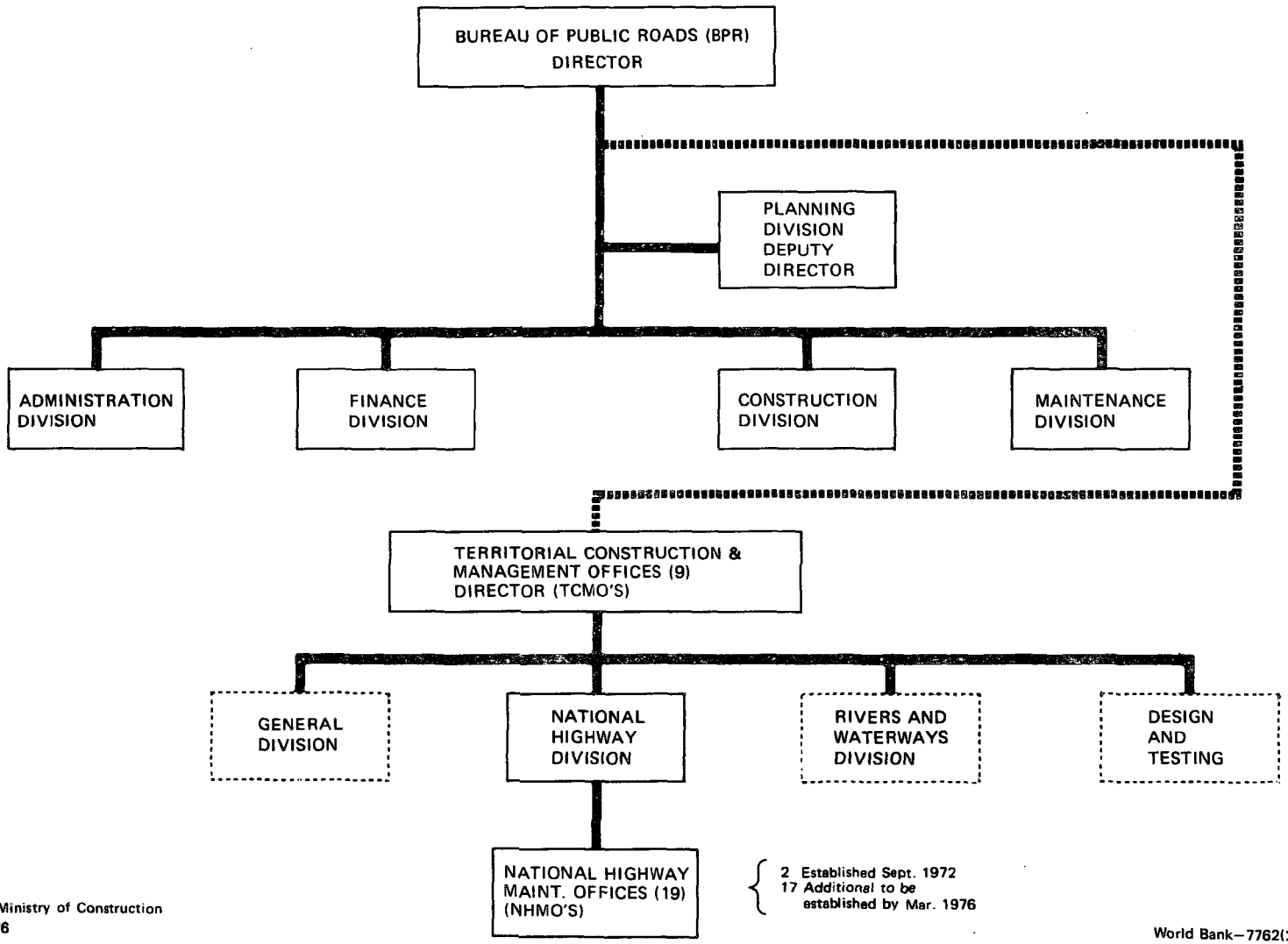


SOURCE: Ministry of Construction
January 1976

World Bank–7761(2R)

CHART 1

KOREA: THIRD HIGHWAY PROJECT
BUREAU OF PUBLIC ROADS ORGANIZATION



SOURCE: Ministry of Construction
January 1976

World Bank—7762(2R)

CHART 2

IBRD-11700
OCTOBER 1975